Cross-examining phonologically-optimizing suppletive allomorphy (POSA):
Five case studies in Irish, Tiene, Katu, Udihe, and Konni

Abstract (100-300 words)
Suppletive allomorphs may be conditioned based on their phonological environment. In many cases, the distribution appears phonologically natural. This has motivated theories of phonologically-optimizing suppletive allomorphy (POSA) whereby the phonological grammar chooses the suppletive allomorph whose output is least marked. This paper cross-examines five case studies from the morphological literature which seemingly support POSA, and shows that each falls short. The first involves Irish plural suffix suppletion, where I argue that a POSA interpretation is undermined by the fact that *ad hoc* phonological constraints must be posited to actually induce optimization. Second, in Tiene I argue that the relevant stems supporting POSA are essentially limited to six forms that are not actually multi-morphemic (i.e. there is no synchronically separable affix). The next two are in Katu and Udihe, which I argue do not constitute suppletion because the surface forms can be derived from one underlying representation (such as by adopting gradient representation for underlyingly 'weak' consonants). The final study is in Konni, for which I argue that the suppletive morphs in question are not actually in competition, and if they were it would predict many more instances of POSA in Konni than are found. This paper asserts that the most straightforward analysis is simply to formalize the conditioning phonological environment via subcategorization frames, and that the burden of proof falls on the pro-POSA camp to show otherwise. Subcategorization correctly predicts that subcategorized phonological material is the only phonological material which suppletion is sensitive to.

Keywords (5)
suppletion, phonologically-conditioned allomorphy, optimization, subcategorization, phonological representations

1 Introduction[1]

This paper explores the intersection of suppletive allomorphy and phonological optimization. SUPPLETIVE ALLOMORPHY can be defined as two (or more) stored exponents in complementary distribution that realize the same morpho-syntactic features. A prototypical example is in (1).

(1) Prototypical example of suppletive allomorphy: ***good*** /ɡʊd/ and ***bett**-er* /bɛt/ (ˣ*good-er*)

While this definition is fairly uncontroversial, the criteria used for precisely identifying cases are often only implicit and/or incomplete. The criteria adopted for this paper are in (2), drawn from many sources on suppletion.[2]

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[1] [*Acknowledgments to be included*]. Note that throughout I exclusively use the asterisk * as indicating reconstructed forms, and use a superscripted ˣ to indicate ungrammatical/unattested.

[2] Different authors highlight different criteria for deciding whether two allomorphs are suppletive or not. Literature emphasizing whether the forms are phonologically distinct ("maximally irregular in form" in the Surrey Suppletion Database – Brown, Chumakina, Corbett, & Hippisley 2003) include Carstairs (1990:17), Mel'čuk (1994), Veselinova (2006), Corbett (2007), Bobaljik (2012:1), Borer (2013), Vafaeian (2013:114), Bauer (2016:341), and Smith, Moskal, Xu, Kang, & Bobaljik (2019:1030). Partially overlapping, other literature points to the lack of generalizability of the alternation and/or the underivability of one morph from the other, e.g. Carstairs (1990:18), Mel'čuk (1994:390), Veselinova (2006:*xv*,47ff.), Embick (2010:43), Inkelas (2014:153-154 fn5), and Paster (2016:96). A smaller number of works emphasize the phonological, phonetic, and typological plausibility of a potential rule which would derive the forms from one underlying representation, e.g. Kiparsky (1996) and Paster (2006, 2016).

(2) Criteria for identifying suppletive allomorphy

a. **Phonological distance of forms**: two allomorphic forms F_1 and F_2 are suppletive if they exhibit phonological distance past a threshold T, measured in phonological structure

b. **Uniqueness of alternation**: two allomorphic forms F_1 and F_2 are suppletive if the alternation is not found in comparable morpho-phonological contexts

c. **Phonological naturalness of alternation**: two allomorphic forms F_1 and F_2 are suppletive if the alternation cannot be derived via a phonologically natural rule (e.g. with respect to phonological locality, typological precedence, *etc*.)

This paper examines two types of phonologically-conditioned suppletive allomorphy, where the trigger of the alternation is a phonological property of the environment (as opposed to a morpho-lexical or morpho-syntactic feature). The first type shows a distribution which appears to have nothing to do with phonological markedness, and constitutes a showcase example of (phonological) 'arbitrariness' in suppletion. One often-cited example of a phonologically arbitrary distribution is perfective aspect in the Mayan language Tzeltal [tzh]. The perfective has two suppletive allomorphs: /-oh/ appears with monosyllabic stems and /-ɛh/ appears elsewhere.

(3) Tzeltal perfective allomorphy (Paster 2006:171, citing Walsh Dickey 1999:328-329 based on Brown 1996)

a.	j-al-**oh**	'he has told something'
	s-mah-**oh**	'he has hit something'
	s-kutʃ-**oh**	'she has carried it'
b.	s-tikun-**ɛh**	'he has sent something'
	s-mak'lin-**ɛh**	'he has fed someone'
	s-kutʃ-laj-**ɛh**	'she was carrying it repeatedly'

Although the only two mid vowels in Tzeltal are /o/ and /ɛ/ and therefore have a standing similarity, they show no active alternations, nor would such an alternation make sense based on syllable count. A common way to analyze such arbitrary distributions is through subcategorization frames. As analyzed by Paster (2006:214), the /-oh/ suffix "left-subcategorizes for a verb stem with only a single syllable", while /-ɛh/ "left-subcategorizes for a verb stem with no phonological requirements", and is therefore the elsewhere form.

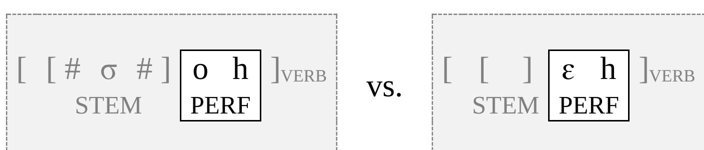


Figure 1: Tzeltal distribution of perfective allomorphs (after Paster 2006)
Subcategorization frames of *-oh* (w/ 1σ stems) vs. *-ɛh* (elsewhere)

In the second type, the distribution is phonologically natural and therefore appears to be less arbitrary. This can be seen in the also well-cited example of 3SG.M allomorphy in Moroccan Arabic [ary], where an enclitic /-h/ appears after vowels but /-u/ appears after consonants.

(4) Moroccan Arabic 3SG.M clitic /-h/ vs. /-u/ (Mascaró 2007:717, citing Harrell 1962)

a.	xtˤa-**h**	'**his** error'	b.	ktab-**u**	'**his** book'
	ʃafu-**h**	'they saw **him**'		ʃaf-**u**	'he saw **him**'
	mʕa-**h**	'with **him**'		menn-**u**	'from **him**'

The distribution shows something of a conspiracy: both avoid adjacent vowels/consonants, which would constitute more marked patterns (i.e. ^{x}[xt^{ʕ}a=u] and ^{x}[ktab=h]).

Examples like these showing phonologically natural distributions support interpretations that these morphs are not arbitrarily indexed to certain phonological environments (as under subcategorization). Rather the allomorph choice is determined by the phonology, and as such constitutes the emergence of the unmarked (TETU). This interpretation entails that the morphology underdetermines their distribution and as such both stored suppletive allomorphs enter the phonological input. As modeled by Mascaró (2007, a.o.), the allomorphs are "lexically organized as a partially ordered set" in the input and are subject to evaluation by the phonological grammar. The least marked output is chosen as optimal, as shown in Tableau 1.

		xt^{ʕ}a + {-h, -u}	Onset	NoCoda
a.	☞	xt^{ʕ}a-**h**		*
b.		xt^{ʕ}a-**u**	*!	

Tableau 1: Moroccan Arabic allomorph set in the input (the least marked output is chosen)

Models where the choice of suppletive allomorph is determined by the phonological grammar support phonologically-optimizing suppletive allomorphy (POSA).[3] The central thesis of this camp is that when (suppletive) allomorphy has a phonologically natural distribution, allomorphic choice is guided by phonological optimization of the output.[4] Such models support "the conclusion that global optimization, which crucially references the [prosodic] well-formedness of output structures, is needed in allomorph selection" (Yu 2017:5). In contrast, models which "refuse to countenance a role for surface optimization in allomorph selection therefore fall short on explanatory grounds" (Bennett 2017:270), such as "suffer[ing] from a version of the Duplication Problem … where the same phonological condition is enforced both in allomorph selection and in the language's phonotactics" (Wolf 2008:424).

The alternative models (alluded to above, e.g. Paster 2006) reject phonological optimization in suppletive allomorph selection, and accomplish both phonologically arbitrary and phonologically natural distributions via a central morphological mechanism, such as subcategorization.[5] The core assertion is that allomorphy selection takes place in a separate pre-phonological stage rather than by the phonological grammar. Under this approach, phonologically-optimal outputs are incidental products of other pressures (e.g. diachrony), rather than due to synchronic architecture.

We can call these two camps the pro-POSA and anti-POSA camps. The goal of this paper is to support the anti-POSA camp and against the existence of phonologically-optimizing suppletive allomorphy generally. To do so, I examine five case studies of what at first glance appear to be phonologically natural distributions of suppletive allomorphy, and for each show how it falls short of supporting POSA. These studies are on Tiene, Katu, Irish, Konni, and Udihe. The first four have been claimed overtly to support POSA (Yu 2017 for the first two, Bennett 2017, and Wolf 2008, respectively), but none have been cross-examined from an anti-POSA perspective. The last, Udihe,

[3] Proponents in this camp start with the so called 'P >> M' models *à la* McCarthy & Prince (1993a, 1993b), and thereafter include Mester (1994), Tranel (1996), Kager (1996), Mascaró (1996, 2007), Hyman & Inkelas (1997), Booij (1998), Bonet (2004), González (2005), Elías-Ulloa (2006), Bonet, Lloret, & Mascaró (2007), Wolf (2008, 2015), Kim (2010), Anderson (2011), Bermúdez-Otero (2012), Smith (2015), Yu (2017), Bennett (2017), Brinkerhoff (2019), and de Belder (2020). I include in here any models which include a role for phonological grammar to dictate suppletive allomorph choice, even if subcategorization (or something equivalent) is employed for other types of allomorphy.

[4] The 'output' here can refer to the surface output (what is typically implied), or an intermediate output in a cyclic model of phonology (e.g. distinguishing outputs in lexical vs. post-lexical stages – Bennett 2017:259).

[5] Proponents in this camp include Paster (2006, 2009, 2015), Bye (2008), Embick (2010), Gouskova, Newlin-Lukowicz & Kasyanenko (2015), Pak (2016a, 2016b), Stanton (2020), and Kalin (2020).

has been presented in the morphological literature (Bye 2008, Nevins 2011) in such a way that it appears to support POSA, and later received an analysis as non-suppletion in Scheer (2016). I present Udihe to argue for an analysis superior to all previous authors.

The driving motivation for this study is the continuing development of a fully modular phonological component in grammar, in which sensitivity to morphosyntactic and phonetic features is limited to phonological interfaces, an approach we can call MODULAR PHONOLOGY.[6] A central hypothesis of this approach is that morphological operations (such as exponent choice) may have access to phonological structure (i.e. the underlying representations of morphs, in the input), but not to the phonological grammar itself nor to the results of its application (e.g. which allomorph results in the least phonologically marked output). Under Modular Phonology, the input can only contain material and structure which is 'readable' by the phonological grammar. In other words, in the tableau from Mascaró above repeated in Tableau 2 (and other "multiple inputs analys[e]s" – Scheer 2016), a modular phonological grammar cannot interpret the notations of the 'partially ordered set' (i.e. the brackets and comma, in red).

Input: xtˤa + {-h, -u}	ONSET	NOCODA
a. ☞ xtˤa-h		*
b. xtˤa-u	*!	

Tableau 2: Part of input (in red) which cannot be interpreted under Modular Phonology

This paper is organized as follows. Section 2 discusses Irish, based around Bennett (2017). Section 3 presents a reanalysis of Tiene and section 4 a reanalysis of Katu, both based around Yu (2017). Section 5 discusses Udihe and argues that for a proposal superior to Scheer's (2016) counter-analysis. Section 6 discusses Konni based on Wolf (2008). For all case studies, I supplement the presentation with data from that language's literature to support my positions. Section 7 provides a discussion of pro- and anti-POSA positions generally, and section 8 provides a brief summary.

2 Irish

The first case study involves Irish [gle] (Celtic, Indo-European: Ireland), which unlike the other cases is an authentic instance of suppletive allomorphy. A presentation of Irish allomorphy as phonologically-optimizing follows data and argumentation in Bennett (2017), hereafter B17. The focus is on plural marking in nouns, looking at several modern dialects.

To begin, a sample of plural marking is in Table 1 (from Bennett 2017:230), such as a suffix ([-ə], [-ənə] in a.-b.), marked by some change in the stem (palatalization in c.), or some combination (d.).

	Noun	Singular	Plural	Gloss	
a.	*cloch*	klox	klox-ə	'stone(s)'	
b.	*deoch*	dʲox	dʲox-ənə	'drink(s)'	
c.	*bád*	bɑːd	bɑːdʲ	'boat(s)'	
d.	*capall*	kɑpəl	kapʲlʲ-ə	'horse(s)'	*etc.*

Table 1: Sample of plural marking in Irish

[6] A diverse number of phonological models have emerged which have modularity as a core tenet, but are otherwise quite distinct in their details and assumptions. For different perspectives and extensive discussion of modularity and phonology, see Raimy & Cairns (2009) and Scheer (2011, 2016, 2020), among many others.

Bennett demonstrates that despite Irish plural marking being notoriously 'erratic' – there are at least 26 ways to form plurals (Ó Siadhail 1991:159) – there is evidence for a productive sub-pattern involving two suffixes.[7] One suffix is -(*e*)*anna* [-ənə] or -(*e*)*annaí* [-ənɪ]~[-əni] depending on the dialect, and the other is -(*e*)*acha* [-axə]~[-ɑxə]. Bennett takes on the difficult task of normalizing patterns and surface forms across numerous Irish dialects and authors, resulting in the multiple orthographic/phonological variants seen. Because of this, I shall refer these two suffixes as the N-form and the X-form in what follows so as to abstract away from these details. When dialect differences become important, this is noted overtly.

The N-form and X-form are mostly in complementary distribution, seen in (5). The N-form appears after 1σ roots (a.), while the X-form appears elsewhere, such as the vast majority of 2σ roots (b.). Importantly, after a 2σ root with irregular final stress, Bennett states that the N-form occurs (c.). This reveals that the conditioning property is the location of stress rather than syllable count *per se*. Note that in the original source (Hickey 1985), there is variation between the N- and X-form with such a form (repeated in c., using the original transcription rather than IPA).[8]

(5) Irish plural suppletion conditioned by stress in the stem

a.	ˈσ	*loch*	[ˈlox]	→	*loch**annaí***	[ˈlox-**əni**]	'lake(s)'	[B17:231]
b.	ˈσσ	*gráinnín*	[ˈgrɑːnʲiːnʲ]	→	*gráinní**neacha***	[ˈgrɑːnʲiːnʲ-**axə**]	'grain(s)'	[B17:232]
c.	σˈσ	*meaisín*	[mʲæːˈʃiːnʲ]	→	*meaisí**neanna***	[mʲæːˈʃiːnʲ-**ənə**]	'machine(s)'	[B17:232]
					(note: /ma's'i:n**əni:**/~/ma's'i:n**əxi:**/		[Hickey 1985:159])	

While there are exceptions (*uibheacha* [ˈɨvʲ-ɑxə] 'eggs', where we expect the N-form), one generalization holds across dialects: the N-form never appears with [ˈσσ] stress patterns. In other words, the N-form *must* be adjacent to stress. Bennett emphasizes that the N-form and X-form are suppletive with no common underlying representation: no n/x alternation exists in Irish, nor would such an alternation make sense based on the stress or syllable count of the stem.

To understand the argument why this is phonologically-optimizing requires a brief excursion into the Irish stress and weight system. One set of Irish dialects focused on are West Ulster (in the North) and Achill (in the West), which have quantity-insensitive stress. By default, stress is always on the first syllable of the word. This holds even if it results in a non-optimal trochee, e.g. *gabáiste* 'cabbage' /gɤbɑːʃtʲə/ maps to [(ˈ**gɤ**.bɑːʃ).tʲə]. There exist a handful of exceptional forms with pre-specified stress on a non-initial position, e.g. *meaisín* [mʲæː.(ˈ**ʃiːnʲ**)] in (5) above.

While these dialects exhibit regular quantity-insensitive initial stress, in contrast Munster Irish (in the South) is quantity-*sensitive* and does not show uniform initial stress. This is exemplified in (6), simplifying for our purposes.[9] Essentially, long vowels and diphthongs are heavy and attract stress (a.), which otherwise appears initially when only light syllables occur (b.).

[7] See Bennett (2017:234) for sources discussing their productiveness. Some representative quotations are from Hickey (1985): "now the vast majority of monosyllabic loan-words also have the /əni:/...in the plural" (p. 157, citing de Bhaldraithe 1953a:42f.), and "where these are disyllabic the infix /əx/ is always found...seen clearly with loan-words" (p. 158, citing de Bhaldraithe 1953b:22).

[8] As Bennett reminds the reader, Irish plural formation is subject to extensive variation. For example, Carnie's (2008:227) reference guide to Irish nouns has *meaisín-**í*** as the plural of 'machine', with a suffix /-iː/ rather than either an N- or X-form.

[9] Munster Irish stress is notoriously complex and without consensus even descriptively (see in particular findings contradictory to the general literature in Blum 2018).

(6) Irish quantity sensitive stress in Munster dialect in the South (B17:240)

a.	*marcaraer*	'mackerel'	[mar.kə.ˈ**reːr**]	LLˈ**H**	(cf. Western dialects: [ˈ**mar**.kə.reːr])
b.	*anagal*	'corrupt matter'	[ˈ**a**.nə.gəl]	ˈ**L**LL	

Closed syllables are light in Munster Irish with the exception of one type of rime: sequences of /ax/. These exceptionally attract stress if they appear in the second position of the word, shown in (7) below (in a.). Such sequences only have 'intermediate' prosodic weight, as they do not attract stress if they appear in the third position (b.), nor do they if a long vowel/diphthong is present (c.).

(7) Munster Irish quantity sensitive stress with /ax/ sequences (B17:240-241,253)

a.	*bacach*	'lame'	[bə.ˈ**kax**]	L.ˈ**ax**	(cf. other dialects: [ˈ**L**.ax])
	slisneacha	'chips'	[sliʃ.ˈ**nʲax**.ə]	L.ˈ**ax**.L	
b.	*Sasanach*	'English person'	[ˈ**sa**.sə.nəx]	ˈ**L**.L.ax	
c.	*léimeacha*	'jumps'	[ˈ**lʲeː**.mʲə.xə]	ˈ**H**.ax.L	

To capture this behavior of /ax/ sequences, Bennett analyzes them as a quasi-diphthong where /x/ is moraic (and as such, parsed within the same syllable – a. above), i.e. a representation [ax$_{\mu}$]. An important assumption is that although the other dialects are quantity-insensitive, Bennett contends that in the absence of counter-evidence /ax/ sequences in *all* dialects should be represented as [ax$_{\mu}$].

Having established these phonological properties, we are now prepared to see the argument for Irish plural allomorphy as phonologically-optimizing. In essence, the N-form plural appears after stressed syllables because an X-form in this context would constitute a (semi-)heavy syllable in a weak position, i.e. a structure [ˈσ.H]. Consider the noun *loch* [ˈlox] 'lake' in (8) below (and keep in mind that the forms below are from quantity-*in*sensitive West Ulster/Achill varieties, and *not* from quantity-sensitive Munster). As a non-exceptional monosyllabic noun bearing stress, it takes the N-form for its plural, *lochannaí* 'lakes' [(ˈlo.xə).nɪ]. If the form were to take the X-form, it would be parsed as ^{x}[(ˈlo.xax$_{\mu}$).ə] by the stress algorithm. This would generate a non-optimal trochaic foot, namely a stressed syllable followed by a (semi-)heavy unstressed syllable with [ax$_{\mu}$]. Here we see why it is important that /x/ be moraic even in these quantity-insensitive dialects.

(8) Irish plural optimization *loch* → *loch-annaí* 'lake(s)' to avoid non-optimal trochee [ˈσ.H]

a.	N-form:	more optimal (ˈL.L) trochee	[(ˈlo.xə).nɪ]
b.	X-form:	less optimal (ˈL.H) trochee	^{x}[(ˈlo.xax$_{\mu}$).ə]

The same logic holds for the exceptional roots with final stress (e.g. *meaisín* [mʲæː.(ˈ**ʃiːnʲ**)]), which also appear with the N-form (notwithstanding the variation indicated). Because the plural marker has *two* morph choices, the grammar can choose the less phonological 'costly' of the two. This choice is not available for the majority of morphological constructions (such as unmodified nouns like 'cabbage' /gɤbɑːʃtʲə/), and thus the phonology does not play a deciding role.

Unlike the previous cases we have examined, the plural morphs /ənə/ and /axə/ are clearly a case of suppletive allomorphy. Moreover, based on the arguments Bennett presents regarding the representation and distribution of plural forms, it is true that forms with /axə/ are absent which would have contained sub-optimal feet. The question now becomes, is this a genuine case of surface optimization where the phonology chooses the allomorph? I argue that it is not, based on four counter-arguments.

First, an analysis as optimization rests on the assumption that /ax/ constitutes a (semi-)heavy syllable [ax$_{\mu}$], even in those quantity-insensitive dialects for which there is no evidence from stress. This position has been challenged even in the quantity-sensitive dialects like Munster Irish which justified this representation in the first place. Recently, Kukhto (2019) re-examines those words in

Munster Irish like *bacach* 'lame' [bə.ˈ**kax**] where the rime /ax/ exceptionally 'attracts' stress away from its expected initial position. His central claim is that "in words with exceptional stress on /ax/ in the second syllable, the first syllable contains a phonologically reduced vowel /ə/, which blocks the stress and makes it shift to the second syllable" (p. 1566). This reorients the interpretation of words like *bacach*: /ax/ does not attract stress but rather the initial /ə/ repels it.

Kukhto provides numerous arguments for this position which I briefly recap. From phonetic measurements, he shows that before stressed /a/ (which includes words containing /ax/), only [ə] appears. That this is underlying /ə/ is supported by several phonological arguments. One is that a sequence /ax/ in second position does not always attract stress away from a short vowel, e.g. *cnocach* [ˈknʊ.kəx] 'hilly' (not ^{x}[knə.ˈkax]). Kukhto points out this even includes pronunciations of unfamiliar words. Another argument is that if /ax/ is preceded by schwa, it cannot undergo stress retraction. Compare *corcán* [kərˈkɑːn] 'pot' in the phrase *corcán mór* [ˌkɔrkɑːn ˈmuːər] 'big pot' where it shows stress shift, to *bodach* [bəˈdax] in *bodach mór* ^{x}[ˌbɔdəx ˈmuːər] 'bigwig' where stress shift is *not* possible. If Kukhto's arguments hold, then evidence for optimization involving /ax/ is essentially nullified.

The second counter-argument against Bennett is that subcategorization is required to account for the majority of the Irish plural system, even if we accept that a corner shows phonological optimization. This is seen in the numerous strategies to form plurals in the language, which have to be arbitrarily indexed to certain lexical, morphological, or phonological environments. Even among the productive areas of the plural system (e.g. as seen in loanwords), it is certainly not the case that only /ənə/~/axə/ optimizing patterns occur. Numerous patterns with loanwords are documented as in (9), many occurring with plural /-i:/ (a.-c.), with or without other changes such as [t]-epenthesis. Particularly interesting are the three loans in d.-e. which correspond to words with final stress in English. From Carnie (2008), one word is exceptionally pluralized with an X-form (d.) while another shows internal palatalization modification (e.) (pronunciations are transcribed by me, based on teanglann.ie).

(9) Irish range of plural strategies in loanwords

a.	*seó*	s'o:	→	s'o:**t'i:**	'show(s)'	(Hickey 1985:148; cf. *seónna* – Carnie 2008:255)
b.	*tornapa*	tʌrnɪpɨ	→	tʌrnɪp**i:**	'turnip(s)'	(Hickey 1985:154)
c.	*draein*	dre:n'	→	dre:n**təxi:**	'drain(s)'	(Hickey 1985:149; cf. *draenacha* – Carnie 2008:101)
d.	*canáil*	[kəˈnɑːlʲ]	→	*canál**acha***	'canal(s)'	(Carnie 2008:89; teanglann.ie)
e.	*patról*	[pəˈtroːl]	→	*patró**il***	'patrol(s)'	(Carnie 2008:238; teanglann.ie)

While certainly variation exists, this demonstration is meant simply to illustrate that marginal role of optimization in but a small sample of loans.

Bennett in fact concedes that in certain dialects *only* the subcategorization approach is available, due to internal changes in the pronunciation of plural markers. As stated, the optimization analysis is only viable if /ax/ sequences are (semi-)heavy. However, in certain dialects of Connacht (in the west) and East Ulster (in the north) such sequences are always pronounced /əx/, for which there is no evidence they are anything but regular light syllables.

	West Ulster (N)	Achill (W)	Munster (S)	Connacht (W)	East Ulster (N)
Stressed:	ˈaxə	ˈaxə	ˈaxə	ˈəxə~ˈəxiː	ˈəxə~ˈəhə
Unstressed:	axə	axə	əxə	əxə~əxiː	əxə~əhə
	Optimizing			Non-optimizing	

Table 2: Irish realizations of /ax/ sequences across dialects

Even in these non-optimizing dialects, the principle conditioner of N-form vs. X-forms is syllable count. Therefore, using subcategorization frames exclusively of the type '[PL] ↔ N-form / 1σ __' allows us to unify all Irish dialects (*modulo* alternations in the frames of dialects like Achill where the N-form may also be used after a stressed σ).

Thirdly, another unexpected fact under the optimization interpretation is that there are many exceptional X-forms, but no exceptional N-forms. This is demonstrated below:

	Normal	Exceptional
N-form	(ˈ**σ**-ə)nə	^{x}(ˈ**σ**σ)-ənə
X-form	(ˈ**σ**σ)-axə	(ˈ**σ**-ax)ə

Table 3: Irish exceptional patterns with N- and X-forms

This is surprising from the view of optimization because the exceptional X-forms of the shape [(ˈσ-ax)ə] are examples of non-optimal feet [ˈσ.H]. In contrary, N-forms of the shape ^{x}[(ˈσσ)-ənə] are non-existent, even though they would not result in marked non-optimal feet. We might expect this situation to be reversed if phonological optimization played a central role in allomorph choice.

The fourth and final counter-argument involves dissecting the phonological grammar itself, and what counts as evidence for the emergence of optimization. In quantity-insensitive Irish dialects, stress is uniformly realized at the left-edge regardless of weight. Bennett captures this in a grammar where constraints enforcing binary trochees (FTBIN and TROCHEE) and aligning all feet to the left edge (ALLFTL) are ranked high. Other constraints are ranked low, such as ones enforcing exhaustively parsing syllables into feet (PARSE(σ)) and the Weight-to-Stress Principle where stress must fall on heavy syllables (WSP). A sample Optimality Theoretic tableau is provided below, with the light-heavy-light word /gɤbɑːʃtʲə/ 'cabbage'.

/ gɤbɑːʃtʲə /	FTBIN	TROCHEE	ALLFTL	PARSE(σ)	WSP
a. ☞ (ˈ**gɤ**.bɑːʃ).tʲə				*	*
b. gɤ.(ˈ**bɑːʃ**).tʲə			*!	**	
c. (gɤ.ˈ**bɑːʃ**).tʲə		*!		*	
d. (ˈ**gɤ**).bɑːʃ.tʲə	*!			**	*

Tableau 3: Irish quantity insensitive stress grammar (B17:249 – *gabáiste* 'cabbage')

The core advantage Bennett's analysis is its explanatory power: "why the suffix alternation /-axə/~/-ənə/ is conditioned by stress" can be reduced to "general properties of the phonology of Irish" in an analysis as optimization, whereas subcategorization theories "must recapitulate the same phonological generalization(s) in distinct components of the grammar" (B17:266).

At issue is exactly which 'general properties of the phonology' are charged with differentiating allomorph candidates. I contend that Bennett's claim falls short, as the exact constraints which differentiate between allomorphs are introduced *solely* to account for the distributional quirk of N- and X-forms. In other words, the constraints which optimize one allomorph over the other are not actually independently needed by the phonology.

To demonstrate this, consider the amalgamated Tableau 4 with four kinds of inputs (labeled A-D). This builds on the phonological grammar from Tableau 3. Below, input A involves a non-exceptional 2σ root in a plural context which must choose between the X- and N-form, as indicated by the notation {-axə > -ənɪ}. This conventionalizes that all else being equal, the X-form is preferred over the N-form, enforced by the constraint PRIORITY (Mascaró 2007). All outputs which have the N-form therefore violate PRIORITY by choosing the less preferred allomorph. For Input A, we see that PRIORITY solely differentiates between the X-form (chosen) and the N-form (not chosen), which are otherwise equally optimal with respect to the higher ranked phonological constraints. PRIORITY in fact must be ranked above the weight-to-stress constraint (WSP).

By its very nature as differentiating equivalent morphological forms, PRIORITY has no role in the ambient phonological grammar. In all works which employ PRIORITY, it cannot be strictly speaking true that phonology alone chooses between candidates. Like the subcategorization approaches, certain arbitrary distributions must be encoded directly which do not fall out of any other (synchronic) principle. With respect to Irish, there is nothing about the prioritized /axə/ which makes it inherently less (phonologically) marked than /ənə/.

Input A: / rɨlʲikʲ / + {-axə > -ənɪ}				TROCHEE	ALLFTL	PARSE(σ)	WSP$_{Ft}$	**PRIORITY**	WSP
a.	☞	(ˈ**rɨ**.lʲi).kʲax$_{\mu}$.ə	**X-form**			**			*
b.		(ˈ**rɨ**.lʲi).kʲə.nɪ	N-form			**		*!	
Input B: / lox / + {-axə > -ənɪ}				TROCHEE	ALLFTL	PARSE(σ)	**WSP$_{Ft}$**	PRIORITY	WSP
a.	☞	(ˈ**lo**.xə).nɪ	**N-form**			*		*	
b.		(ˈ**lo**.xax$_{\mu}$).ə	X-form			*	*!		*
Input C: / ʃɪːg / + {-axə > -ənɪ}				TROCHEE	ALLFTL	PARSE(σ)	**WSP$_{Ft}$**	PRIORITY	WSP
a.	☞	(ˈ**ʃɪ**ː.gə).nɪ	**N-form**			*		*	
b.		(ˈ**ʃɪ**ː.gax$_{\mu}$).ə	X-form			*	*!		*
c.		(ˈ**ʃɪ**ː).gax$_{\mu}$.ə				**!			*
Input D: / də.ˈ**gʲrʲi**ː / + {-axə > -ənə}				TROCHEE	ALLFTL	PARSE(σ)	**WSP$_{Ft}$**	PRIORITY	WSP
a.	☞	də.(ˈ**gʲrʲi**ː.ə).nə	**N-form**		*	**		*	
b.		də.(ˈ**gʲrʲi**ː.ax$_{\mu}$).ə	X-form		*	**	*!		*
c.		(də.ˈ**gʲrʲi**ː).ax$_{\mu}$.ə		*!		**			*

Tableau 4: Irish constraint grammar (quantity-insensitive Achill and West Ulster dialects)

Inputs B-D also demonstrate that the phonological grammar alone (justified by purely phonological patterns) falls short of accurately choosing forms. Consider Input B with a 1σ root. Based on PRIORITY, the X-form should be chosen here, because it crucially must dominate the constraint WSP. However, this is not the case: the surface form is [(ˈ**lo**.xə).nɪ]. To solve this paradox, Bennett clones a WSP constraint which only applies to footed heavy syllables (WSP_{FT}). With this ranked higher than PRIORITY, it correctly rules out the X-form. This equally applies to heavy 1σ roots (Input C) and 2σ roots with exceptional (pre-specified) final stress (Input D).

However, once again this constraint WSP_{FT} plays no role in the Irish phonological grammar otherwise (cf. Tableau 3). This is tacitly admitted (B17:248), where Bennett (2012) is cited which "argues that WSP_{FT} is independently active in the phonology of Conamara Irish, though that dialect group is largely outside the focus of this paper". In other words, in none of the dialects which justify the optimization analysis is WSP_{FT} active.

Under optimization, this must constitute an example of the "emergence of the unmarked" where phonological constraints "PARSE(_) and WSP_{FT} are mostly dormant in the language at large", and "the pressures that they exert are generally too weak to materially affect prosodic structure" (B17:263). The result is an analytic schism: suppletion which looks non-optimizing is modeled as subcategorization, but suppletion which looks optimizing is modeled by adding very low-ranked and typically *ad hoc* constraints to the phonological grammar. I follow a common type of reasoning against this, as found in the subcategorization literature (e.g. Paster 2006): it is conceptually simpler to model both types as subcategorization (which is independently needed) rather than posit such constraints.

3 Tiene

The second case study is on Tiene [tii] (Bantu, Niger-Congo: The Democratic Republic of the Congo), which Yu (2017) showcases as a prime example of phonologically-optimizing suppletive allomorphy. This builds on previous publications where a POSA analysis is at the very least implicated (Hyman & Inkelas 1997, Orgun & Sprouse 1999, Hyman 2010, Inkelas 2014). The relevant data involves so-called verb extensions – derivational affixes with common form-meaning pairings across the Bantu family. In Tiene, verb extensions have numerous surface allomorphs only some of which can be derived through general phonology. Examples are in (10) of the stative (a.), the causative (b.), and the applicative (c.), where the relevant form is in bold. The source of the data is Ellington (1977), supplemented by Hyman (2010) with a few data points from Guthrie (1953, 1960).

(10) Tiene verbal extension allomorphy

a.	Stative	yaat-	'split'	yat-**ak**-	'be split'	[yatak-a]
		kab-	'divide'	ka-**la**-b-	'be divided'	[kalab-a]
		nyak-	'tear'	nya-**la**-k	'be torn'	[nyalak-a]
b.	Causative	mat-	'go away'	ma-**as**-	'cause to go away'	[maas-a]
		lab-	'walk'	la-**sa**-b-	'cause to walk'	[lasab-a]
		lók-	'vomit'	ló-**se**-k-	'cause to vomit'	[lósek-ɛ]
c.	Applicative	bót-	'give birth'	bó-**o**-t-	'give birth for'	[bóot-ɛ]
		yɔb-	'bathe'	yɔ-**lɔ**-b-	'bathe for'	[yɔlɔb-ɔ]
		yók-	'hear'	yó-**le**-k-	'listen to'	[yólek-ɛ]

Although the surface allomorphs are distinct in each case – suffixal -Vk vs. infixal -lV- (with an underspecified vowel), -Vs vs. -sV-, and -V- vs. -lV- – their conditioning environment is the same: whether the stem ends in a coronal or non-coronal consonant. What all the works above emphasize is that this distribution is completely predictable and within the context of Tiene, phonologically natural.

To see why, let us turn to Tiene phonology. The relevant phonological domain is what can be called the extended stem, which consists of the root plus any derivational extensions (ignoring the Bantu final vowel, which is not relevant for our purposes).[10] There are three important templatic features of the extended stem: the limited CV shapes of the extended stem (a.), restrictions on coronal/non-coronal consonants (b.), and agreement in nasality (c.).

(11) Tiene extended stem template restrictions
- a. Shapes: CVVC ~ $C_1VC_2VC_3$
- b. Coronality: C_2 = [+CORONAL] , C_3 = [-CORONAL]
- c. Nasality: C_2 and C_3 must agree for [±NASAL]

Both derived and non-derived stems fit this template, e.g. proto-Bantu *CVCVC stems underwent metathesis to fit this template, e.g. kó**t**o**k**- 'gnaw' (< *kó**k**o**t**), tó**l**e**b**- 'pierce' (< *tó**b**o**d**-), *inter alia* (Hyman 2010, citing Guthrie's reconstructed forms).

Important for this paper, allomorphy choice for derivational suffixes is claimed to be dictated by this template as well. Consider causative and applicative forms in Table 4, taken form (10). Both affixes contain a coronal consonant. If the affix appears with a coronal-final root (a. and c. below), the template cannot be satisfied as there would be coronals in both C_2 and C_3 positions. Instead, only the obstruent coronal surfaces in a CVVC stem, and the other coronal is deleted. In contrast, if the root ends in a non-coronal (b. and d.), the affix straightforwardly infixes to fit the template. All other possible outputs (marked with an x, and greyed out) violate the stem template (or show egregious deletion, e.g. ^{x}yɔɔl-).

	Root	Suffix -VC	Infix -CV-	Infix -VC-		
a.	mat-	^{x}mat-**as**-	^{x}ma-**sa**-t-	^{x}ma-**as**-t-	ma-**as**-	^{x}ma-**a**-t-
b.	lab-	^{x}lab-**as**-	la-**sa**-b-	^{x}la-**as**-b-	^{x}la-**as**-	^{x}la-**a**-b
c.	bót-	^{x}bót-**ol**-	^{x}bó-**lo**-t-	^{x}bó-**o**l-t-	^{x}bó-**o**l-	bó-**o**-t-
d.	yɔb-	^{x}yɔb-**ɔl**-	yɔ-**lɔ**-b-	^{x}yɔ-**ɔ**l-b-	^{x}yɔ-**ɔ**l-	^{x}yɔ-**ɔ**-b-

Table 4: Tiene causative and applicative allomorphs

With these two derivational types, the position and shape of the affix is entirely predictable based on the template. Given the similar forms of the surface allomorphs, it is reasonable to conclude there is only one underlying representation for the suffix, and therefore no suppletion.

The same cannot be said for the stative (shown in Table 5). Here, the two stative forms -Vk and -lV- are also distributed according to the extended stem template: the velar suffix occurs with coronal-final roots (a.), and the coronal infix occurs with non-coronal-final roots (b.-c.). However, these forms cannot be derived from a common form: there is no natural operation which derives [k] from /l/, or vice versa. Hyman & Inkelas (and the works which follow) explicitly treat the stative forms as non-derivable listed allomorphs.[11]

[10] The 'extended stem' is equivalent for our purposes to what Hyman & Inkelas (1997) call the 'derivational stem' (DStem), and what Hyman (2010) refers to as the 'prosodic stem'.

[11] From Hyman & Inkelas (1997): "both the stative and reversive have two lexically listed allomorphs, one coronal (the /L/, which alternates between [l] and [n] according to nasal harmony context) and one velar (the /K/, which alternates between [k] and [ŋ].)". Yu adopts this wholesale: "both the stative and reversive have two suppletive allomorphs, one coronal … and one velar" (p. 10). We treat the reversive shortly.

	Root	suffix -Vk	infix -lV-
a.	yaat-	yat-<u>**ak**</u>-	ˣya-<u>**la**</u>-t-
b.	kab-	ˣkab-<u>**ak**</u>-	ka-<u>**la**</u>-b-
c.	nyak-	ˣnyak-<u>**ak**</u>-	nya-<u>**la**</u>-k-

Table 5: Tiene proposed suppletive allomorphs for stative

Because (i) the distribution is predictable from independent phonological constraints (i.e. the extended stem template) and (ii) it constitutes suppletion, it meets the definition of POSA. Following Yu's logic, this undermines the necessity for subcategorization here.

I am in agreement with this analysis except for one crucial aspect: that there is a dedicated stative morpheme in the language (let alone suppletive allomorphs). Instead, I claim that what we are dealing with is a root with frozen morphology (e.g. of the type *tru-**th***, ***for**-give*, *etc*.). Returning to the original source for Tiene, Ellington (1977:115) states that the stative is quite limited, occurring "with only a relatively small number of simplex radicals". Examining all available sources, there appear to be at most ten stative stems. Six of these forms appear with -Vk, what I refer to as the K-form. Historically, these derive from proto-Bantu stative *-ɪk, and are therefore the diachronically expected forms.[12] In contrast, only four occur with the -lV- infix, which I refer to as the L-form. This is shown in Table 6.

	Root		Extended stem		Cf. proto-Bantu (Zones)[13]
a.	kaa-	'fasten'	ka-<u>**al**</u>-	'be fastened'	*gàng- 'tie up' (B,C) *kàng-/*kàang- (B)
b.	kab-	'divide'	ka-<u>**la**</u>-b-	'be divided'	*gàb- 'divide' (B,C) *gàbɪd 'give away' (B) *gàbʊd 'divide' (C)
c.	nyak-	'tear'	nya-<u>**la**</u>-k-	'be torn'	*nòkʊd 'tear off' (C)
d.	kam-	'twist'	ka-<u>**na**</u>-m-	'be turned over'	*kám- 'squeeze, wring' (B,C) *kámʊd- 'wring' (B,C) *gàdam 'lie on back' (C)

Table 6: Tiene compete set of stative L-forms

It is plausible that several of these may be retentions of proto-Bantu words which have undergone semantic drift. For example, the extended form in b. is relatable to reconstructed forms *gàbɪd 'give away' (Bantu Zone B) or *gàbʊd 'divide' (Zone C), and the form in c. to *nòkʊd 'tear off' (Zone C), *modulo* metathesis of C_2 and C_3, introduced above. The form in d. is straightforwardly relatable to *gàdam 'lie on back' (Zone C), even without metathesis. While Tiene itself is classified as Zone B, it lies at the intersection of Bantu Zones B and C which suggests one should find features of both zones in Tiene.[14]

The common cannon of Bantu stem-extending affixes are in fact severely restricted across Tiene and closely related languages, an observation going back at least to Guthrie's (1953) discussion of the Tende-Yanzi subgroup (B.80) to which Tiene belongs: "a characteristic of this whole group is the absence of regular types of extended radical" (p. 84). Larry Hyman (p.c.) brings

[12] The six K-forms are bóle**k**- 'be broken' (< ból- 'break), fasa**k**- 'be driven through' (< faas- 'drive through'), kóte**k** 'be untied' (kóót- 'untie'), yata**k**- 'be split' (yaat- 'split'), sɔ́nɔ**ŋ**- 'be written' (sɔ́n- 'write'), and vwunye**ŋ**- 'be mixed' (vwuny- 'mix'). Recall that nasal harmony in the extended stem changes /k/ to [ŋ].

[13] Proto-Bantu forms come from Bastin, Coupez, Mumba, & Schadeberg's (2002) *Bantu lexical reconstructions 3* online database (https://www.africamuseum.be/en/research/discover/human_sciences/culture_society/blr).

[14] To quote Ellington, the Tiene-speaking part of Bantu Zone B "is like a peninsula thrust up into and nearly surrounded by Zone C languages" (p. *x*).

up that in their correspondence, Ellington stated that the causative (-Vs vs. -sV-) and applicative (-V- vs. -lV-) are plausibly productive (at least for the community and time he was working). Importantly, it is these two derivations that can be derived from a single UR (interacting with the extended stem template), whereas the unproductive stative cannot.

As alluded to already, another derivation is the 'reversive', which is even more limited. Yu takes the reversive as also showing evidence for POSA, which has the same underlying suppletive allomorphs as the stative – the L-form and the K-form – which are likewise distributed to fit the extended stem template. However, Ellington is very clear on the marginality of reversive forms: "there is also some evidence of a previously existing reversive extension in Tiene. However, the number of obviously related pairs of opposites presently used in the language is quite limited" (p. 123). The complete list of forms is in (12), only two of which appear in a K-form.

(12) Tiene complete list of reversive forms

a.	kót-	'tie'	kó**ó**t-	'untie'	
			kót**ek**-	'be untied'	cf. PB *gáagʊd- 'untie' (C)
b.	yal-	'spread'	ya**a**l-	'roll up'	
c.	vuol-	'open'	vuo**k**-	'close'	
d.	sook-	'put in'	so**le**k-	'take out'	cf. PB *cokʊd- 'pull out' (B,C)
e.	sum-	'stick in ground'	su**ne**m-	'pull out of ground'	cf. PB *cum- 'pull' (C), *cumi- 'stick into ground' (C)

The distribution and semantics of the reversive forms is messier than the stative (e.g. the mixed distribution of forms with coronal-final roots in a.-c.). Like with the stative, several are relatable to proto-Bantu forms directly, e.g. solek- 'take out' (d.) to *cokʊd- 'pull out' (Zones B and C, again *modulo* regular metathesis).

Taken all together, the paucity of stative and reversive forms negates Tiene's support for POSA and essentially renders it irrelevant to the larger debate.

4 **Katu**

Another case study presented by Yu (2017) is nominalization allomorphy in (Western) Katu [kuf] (Katuic, Austroasiatic: Laos; working from Costello 1998). Katu has a number of affixes which derive nouns from verbs, summarized in Table 7. The majority of these affixes must be lexically specified as to which roots they attach to, and there is no predictable phonological distribution. This holds for all of the prefixes, of which there are at least six (a.). Of these, phar- appears to be productive as it applies to loanwords, e.g. phar-hiên 'study, education' (< hiên 'to study', a loan from Lao – Costello 1998:37).

	Form		Distribution			Derived nominalization	
a.	Prefixes		Lexically determined				
	phar-	+	cha	'eat'	→	**phar**-cha	'something eaten'
	ar-	+	kâl	'exchange'	→	**ar**-kâl	'goods exchanged'
	aN-	+	kuôt	'tie knot'	→	**ang**-kuôt	'a knot'
	tar-	+	nil	'make a pattern'	→	**tar**-nil	'a pattern'
	tri-	+	trơs	'chase spirits'	→	**tri**-trơs	'chasing away of spirits'
	i-	+	lêh	'(to) free'	→	**i**-lêh	'the freeing'
b.	ARN-infix		*Irregular*				
	-arn-	+	tôôp	'begin'	→	t-**arn**-ôôp	'beginning'
	-arn-	+	teh	'(to) hammer'	→	t-**arn**-eh	'hammer'
c.	R-infix		2σ root				
	-r-	+	katas	'(to) name'	→	ka-**r**-tas	'name'
	-r-	+	alôôm	'offer gift'	→	a-**r**-lôôm	'gift offered'
d.	A-infix		(CC…)σ				
	-a-	+	plah	'divide'	→	p-**a**-lah	'division'
	-a-	+	kroong	'make fence'	→	k-**a**-roong	'fence'
e.	AN-infix		(CV…)σ				
	-an-	+	tôl	'put post in'	→	t-**an**-ôl	'post'
	-an-	+	kui	'carry on back'	→	k-**an**-ui	'something carried on back'

Table 7: Katu nominalization – Prefixes (unpredictable) vs. infixes (largely predictable)

The situation with infixes is different. Yu (2017) states that while the shape of the infixes (like prefixes) is unpredictable, their distribution is fully predictable (except for the two irregular forms in b.). Rows c.-e. show three infix types: -r-, -a-, and -an-. Yu argues that these reduce to two suppletive allomorphs: /-r-/ and /-an-/. The /-r-/ infix occurs with 2σ roots and appears between the two syllables (c.), while /-an-/ appears with 1σ roots and appears after the first consonant. If the /n/ portion ends up before a sonorant consonant, it is deleted (d.), otherwise it becomes the onset of a second syllable (e.).

Yu assumes these infixes have subcategorization frames which state that /-an-/ be placed after the first consonant, while /-r-/ be placed after the first vowel. Importantly for Yu, these affixes subcategorize for *where* they should be placed, but specifically they do not subcategorize for *when* they should appear in the phonological input in the first place.[15] Rather, "the ultimate choice between the allomorphs is determined by global considerations, namely, the size of the output" (p. 22). Let us demonstrate Yu's position with the input-output mappings in (13), which are given as in Yu. The three relevant types of roots are provided: 2σ (a.), 1σ with an initial CC cluster (b.), and simplex 1σ roots (c.). Each is accompanied by a set of two suppletive infixes which the phonological grammar must choose from.

(13) Katu infix competition (based on Yu)

a.	2σ root	/katas, {-**r**-, -**an**-}/	→	[ka-**r**-tas]	'name'	(cf. ^{x}[k-**an**-atas])
b.	1σ (CC)	/plah, {-**r**-, -**an**-}/	→	[p-**a**-lah]	'division'	(cf. ^{x}[pla-**r**] ~ ^{x}[pla-**r**-h])
c.	1σ	/pỏ, {-**r**-, -**an**-}/	→	[p-**an**-ỏ]	'dream'	(cf. ^{x}[pỏ-**r**])[16]

[15] See Kalin & Rolle (2020) for formalizing the distinction between these two functions of subcategorization as Conditions on Insertion (COINs) versus Conditions on Position (COPs).
[16] The vowel in /pỏ/ is actually written /ó/ with an acute accent in the original source, representing IPA [ɒ]. I choose to write it as /ỏ/ with the *psili* diacritic in this paper so as not to confuse it with a mark for accent/stress.

Notice that the output in all three is a form with exactly two well-formed syllables, demonstrating a conspiracy to produce a disyllabic word. In a., 2σ roots combine with the smaller infix /-r-/ because they already have two syllables. Adding the /-an-/ form would result in either a three syllable output (dispreferred), or require other manipulation such as egregious segment deletion. In contrast, roots with only 1σ combine with the larger infix /-an-/ in order to meet this disyllabic word preference. Notice in b. that the output [p-**a**-lah] deletes the n which is not licensed in coda position before sonorants, as stated above. This is still better than its competitors [pla-**r**] or [pla-**r**-h]. Importantly for Yu, outputs must obey all subcategorization requirements and can only place an infix after the pre-designated pivot (ruling out forms like ^{x}[k-**r**-atas] or ^{x}[pl-**an**-ah], where the infix would be mispositioned).

For Yu, the constraint driving word-formation here is a maximality condition WORD=FT$_{\sigma\sigma}$, which states that "a lexical word must constitute an exact disyllabic foot" (p. 20). This condition is not just a quirk of nominalization infixation, but rather is a pervasive restriction in (Western) Katu. For example in (14), it can result in truncation to accommodate prefixes, such as nominalizing prefixes (a.-b.) or a verbalizing prefix (c.). In all cases, the initial syllable of the root is truncated to comply with the disyllabic foot constraint.

(14) Katu truncation triggered by WORD=FT$_{\sigma\sigma}$ constraint

a.	mamông	'be alive'	→	phar-mông	'livelihood'	(cf. ^{x}phar-**ma**mông)
b.	mimưưl	'perform ritual'	→	ar-mưưl	'ritual with rice and sword'	(cf. ^{x}ar-**mi**mưưl)
c.	pharhôôm	'breath'	→	pi-hôôm	'to breathe'	(cf. ^{x}pi-**phar**hôôm)

Under Yu's analysis, there is infix suppletion (/-r-/ vs. /-an-/) whose distribution is determined from the general phonological grammar (the WORD=FT$_{\sigma\sigma}$ constraint). This meets the definition of POSA. Where I disagree with Yu is in analyzing the two forms as suppletive: on a number of grounds it is better to posit a single underlying representation for this morph. I take this UR to be /-ṛn-/, composed of a syllabic rhotic and a non-syllabic nasal.[17] Under my counter-analysis, the input-output mappings for the three root contexts are as follows:

(15)

		Input (one UR)		Infix placement		Surface		
a.	2σ	-**ṛn**- + katas	→	ka-**ṛn**-tas	→	[ka**r**.tas]	'name'	(the R-infix)
b.	CC	-**ṛn**- + plah	→	p-**ṛn**-lah	→	[p**a**.lah]	'division'	(the A-infix)
c.	1σ	-**ṛn**- + pỏ	→	p-**ṛn**-ỏ	→	[p**a**.**n**ỏ]	'dream'	(the AN-infix)

Notice that like in Yu's analysis, the placement of the infix is not uniform across environments: it appears after the first vowel in the 2σ roots (a.), but after the first consonant in 1σ roots (b.-c.). If we capture infixation placement via subcategorization, then our frame must be flexible enough to capture this difference.

To develop a coherent subcategorization frame, I exploit the commonality between the infix placements: after an initial segment but before the final vowel. I take the final vowel of the word to bear word stress. Such an iambic structure is a pervasive pattern of this family and area (Sidwell 2005, Gehrmann 2018:133, a.o.). Stress is also well-known to be a core pivot for infixation (Yu 2007). The underlying representation for /-ṛn-/ capturing this distribution is in Figure 2. The ● represents a segmental root node of which there are two for the infix, a syllabic rhotic and a nasal. The structure in gray is the structure subcategorized for: the requirement for one or more segmental

[17] My analysis is in the spirit of Horwood's (2008) analysis, but differs in details. Horwood collapses the prefix [ar-] and the infixes [-r-] and [-a-] into a single affix /ar/. As Yu points out, however, Horwood does not discuss the AN-infix forms which makes direct comparison of the analyses incomplete.

roots nodes before the infix (i.e. ●$_n$) and a stressed syllable after it (asterisked).[18] In this way, the precise placement of the infix is underspecified by the frame, and subject to emergence-of-the-unmarked (TETU) effects.

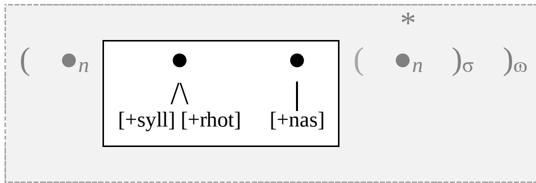


Figure 2: Katu proposed underlying representation of infix /-r̩n-/

This subcategorization frame can be satisfied (and violated) in multiple ways, demonstrated in Table 8. Here, the infix is in red and logically can be placed in a number of distinct positions, under the 'infixation' column. The resulting syllables (with stress) are under the 'syllabification' column, and the possible post-syllabification processes are under 'rime licensing' (i.e. conditions on the nucleus and coda). Those surface forms which fatally violate some constraint are in gray (and marked with superscripted 'x'), followed by the violation.

[18] This representation is with Phantom Structure (Rolle & Lionnet 2020), an additional formalization of subcategorization frames (orthogonal for the purposes). The subscript '*n*' in this figure means any number of segmental nodes (one or more)

		Input		Infixation	Syllabification	Rime licensing	Violation
a.	2σ	-r̩$_1$n$_2$- + katas	→	k-r̩$_1$n$_2$-atas	kr̩$_1$.n$_2$a.ˈtas	^{x}[ka$_1$.n$_2$a.ˈtas]	(No 3σ output)
						^{x}[ka$_1$n$_2$.ˈtas]	(Faith to [+syll])
				ka-r̩$_1$n$_2$-tas	kar̩$_1$n$_2$.ˈtas	[kar$_1$.ˈtas]	
						^{x}[kan$_2$.ˈtas]	(Faith to [+syll])
				kat-r̩$_1$n$_2$-as	ka.tr̩$_1$.ˈn$_2$as	^{x}[ka.ta$_1$.ˈn$_2$as]	(No 3σ output)
				kata-r̩$_1$n$_2$-s	ka.ˈtar̩$_1$n$_2$s	^{x}[ka.ˈtaa$_1$s]	(Be before stress)
b.	CC	-r̩$_1$n$_2$- + plah	→	p-r̩$_1$n$_2$-lah	pr̩$_1$n$_2$.ˈlah	[pa$_1$.ˈlah]	
						^{x}[pa$_1$n$_2$.ˈlah]	(No nasal before [l/r])
						^{x}[pa$_1$r$_1$.ˈlah]	(No breaking)
						^{x}[pa$_1$r$_2$.ˈlah]	(No rhoticization)
				pl-r̩$_1$n$_2$-ah	plr̩$_1$.ˈn$_2$ah	^{x}[pla$_1$.ˈn$_2$ah]	(Be before stress)
				pla-r̩$_1$n$_2$-h	ˈplar̩$_1$n$_2$h	^{x}[ˈplaa$_1$h]	(Be before stress)
c.	1σ	-r̩$_1$n$_2$- + pȯ	→	p-r̩$_1$n$_2$-ȯ	pr̩$_1$.ˈn$_2$ȯ	[pa$_1$.ˈn$_2$ȯ]	(Be before stress)

Table 8: Katu input-output mappings

Let us walk through these data. With a 2σ root there are four possible infix positions (a.), with a CC 1σ root there are three (b.), and with the 1σ root there is only one (c.). From these possible places, syllabification places a syllable boundary between syllabic segments which are separated by one or more non-syllabic segments, and the final syllable is stressed (indicated by IPA ˈ). Notice that the vowel /a/ and syllabic /r̩/ are not syllabified separately.

The critical part of this analysis is in rime licensing, where several changes from the input take place. In line with its iambic foot, the rime structure of non-stressed syllables is quite restricted in (Western) Katu: the rime can only be /i/ or /a/ (and marginally /u/), /ar/, or /aN/ (a nasal unspecified for place) (Costello & Sulavan 1996:238). Under the syllabification column in Table 8, all of these segmentally faithful representations violate rime licensing in some way, and must be modified to obey it (in the next column). These outputs are then assessed as to complying with (i) the core phonological constraints of Katu and (ii) the subcategorization requirements of /-r̩n-/. Some violations of these constraints are recapped in (16).

(16) Katu –Violation types in ungrammatical outputs

a.	Subcategorization	Be before stress	pl-r̩$_1$n$_2$-ah	ˣ[pla$_1$.ˈn$_2$ah]
b.	Word maximality	No 3σ output	k-r̩$_1$n$_2$-atas	ˣ[ka$_1$.n$_2$a.ˈtas]
c.	Phonological	Faith to [+syll]	k-r̩$_1$n$_2$-atas	ˣ[ka$_1$n$_2$.ˈtas]
d.	Phonological	No nasal before [l/r]	p-r̩$_1$n$_2$-lah	ˣ[pa$_1$n$_2$.ˈlah]
e.	Phonological	No breaking	p-r̩$_1$n$_2$-lah	ˣ[pa$_1$r$_1$.ˈlah]
f.	Phonological	No rhoticization	p-r̩$_1$n$_2$-lah	ˣ[pa$_1$r$_2$.ˈlah]

In a., according to the subcategorization frame of the infix its segments must be before the stressed syllable (and not part of it), which eliminates this candidate. Notice that the output [pa$_1$.ˈn$_2$ȯ] of the 1σ root /pȯ/ actually violates this, but since there are no other possible infixation positions the violation is not fatal. In b., outputs with three syllables are not permitted (recall the WORD=FT$_{\sigma\sigma}$ constraint, from Yu). In c., there must be faithfulness to syllabic segments in the input (i.e. vowels and syllabic /r̩/), which disallows their deletion in the output to fit the disyllabic restrictions. Finally, d. disallows nasals before [l/r], e. disallows breaking of a single input segment into two output segments, and f. disallows rhoticization of /n/ to [r]. To license the pre-stress rime, the winning forms either vocalize syllabic /r̩/ to [a] (deleting the feature [+rhot] from Figure 2), lose its syllabicity [r] (deleting the feature [+syll] in Figure 2), and/or delete the [n] entirely.

In total, this counter-analysis shows it is possible to have a single underlier /-r̩n-/ without suppletion, while still recognizing the role of Katu phonology in shaping the *output* of this infix. One objection to this counter-analysis may be that one must assume an underling form /-r̩n-/ which is never found on the surface. However, there are several reasons to think this is not unreasonable. First, in the sister language (Eastern) Katu [ktv] (spoken in Vietnam), the infix [-an-] actually shows variation with [-rn-] in some dialects, e.g. [t-**an**-ʊʊt]~[t-**rn**-ʊʊt] 'stool' (Costello 1966:67).

Second, Gehrmann (2018) reconstructs a number of nominalizing affixes to proto-Katuic, which includes four infixes relevant to our discussion: *-r-, and *-n- (for 1σ-CC and 2σ roots), and *-an- and *-rn- (for simple 1σ roots). This last reconstructed form provides clear precedence for synchronic /-r̩n-/. Gehrmann provides many examples of modern-day reflexes of each across Katuic languages, and describes the semantic and phonological contexts where these infixes are found. However, the precise differentiation of these proto-infixes is tenuous given (i) inexact and overlapping nominal meanings, (ii) their similarity in shape, and (iii) numerous phonological changes in individual Katuic languages which blur a clear diachronic origin (e.g. vocalization of r/n, r-dissimilation, and segment deletions are all attested). In his discussion of the "variability between *a, *r and *n in the presyllable rime part" of this infixes, Gehrmann even states that they all may have been "available to use, if not actually interchangeable, in [proto-Katuic]" (p. 141).

All of this suggests that it is indeed credible that (Western) Katu collapsed this system into a single /-ṛn-/ morph with conditioned surface variants.

The ultimate result is that *all* nominalization is now reduced to lexically-specified affix selection, i.e. the list /phar-/, /ar-/, /aN-/, /tar-/, /tri-/, /i-/, /-arn-/, and /-ṛn-/. There is no phonologically-conditioned selection, and therefore no support for POSA.

5 **Udihe**

The next case study is Udihe [ude], a critically endangered Tungusic language of Russia's far east. This too involves what at first glance appears to be suppletive allomorphy in a phonologically-optimizing distributioben but under close examination turns out not to involve suppletion at all. The discussion of Udihe is based primarily on data from Nikolaeva & Tolskaya's (2001) grammar and its incorporation into studies of allomorphy in Bye (2008:72-73), Nevins (2011:2361-2362), and Scheer (2016:365-367). Although Scheer and I both reject suppletion for Udihe (based on similar reasoning), we differ starkly in our phonological representations. All data come from the Bikin dialect, which differs in some crucial ways from Northern dialects, to be pointed out.

To understand the patterns, let us establish some basic facts of Udihe. Its vowel system consists of three series: short vowels, long vowels, and creaky vowels.

a.	Short series	b.	Long series	c.	Creaky series
	i (y) u ø ə o æ a <ü> <ö> <e> <ä>		i: (y:) u: ie ø: ə: o: æ: a: <ü:> <ö:> <e:> <ä:>		ə̰: o̰: æ̰: a̰: <'e> <'o> <'ä> <'a>

Table 9: Udihe vowel system

The vowel quality /y/ (transcribed <ü>) is marginal and placed in parentheses. Likewise, underlying /ø/ <ö> and /æ/ <ä> are more restricted than other vowels and subject to differing interpretations (see Ko 2012:289ff.). The diphthongoid vowel /ie/ occupies the long front mid vowel slot (i.e. 'e:') in the long series, and has no short counterpart. What is transcribed as <e> is actually /ə/ across the literature on Udihe (Nikolaeva & Tolskaya 2001:36). Most important for the allomorphy discussion are the creaky vowels, which may also be termed laryngealized or pharyngealized vowels. Although they are written as a single vowel preceded by an apostrophe <'V>, they are "phonologically bimoraic, as is indicated by the facts of stress placement" (p. 39) and thus should be regarded as long vowels. There is no short creaky series.

The inventory of creaky vowels is smaller than its non-creaky counterparts, and entirely lacks high vowels (as well as /ie/ and /ø/). In the Russian phonetic literature, it has been classified as an 'interrupted' vowel with a (brief) medial stop (e.g. [aˀa]) or as involving special 'tense' articulation of the pharynx. I follow Nikolaeva & Tolskaya in treating creakiness as an additional feature of the vowel, and not a separate segmental consonant /ʔ/.

With this in mind, let us examine the allomorphy in question, presented along the lines of Nevins (2011). In (17), perfect aspect with verbs is marked primarily by adding creaky voice to final vowel (a.), a type of suprasegmental morphological marking which we can call [+constricted glottis] ([+cg]), following Nevins. Recall also that all creaky vowels are bimoraic, hence written with two vowels. In contrast, creakiness is not added to high vowels (b.), which are not possible creaky vowels (Table 9 above). If the root ends in a high vowel, the suffix <-ge> is added instead.

(17) Udihe perfect allomorphy [+cg] vs. <-ge> (Nikolaeva & Tolskaya 2001:207,210-211)

a.	<etete>	/ətətə/	→	<etet'e>	ətət**ə̰ə̰**	'work\PERF'
	<zawa>	/zawa/	→	<zaw'a>	zaw**a̰a̰**	'grab\PERF'
	<olokto>	/olokto/	→	<olokt'o>	olokt**o̰o̰**	'cook\PERF'
	<tukä>	/tukæ/	→	<tuk'ä>	tuk**æ̰æ̰**	'run\PERF'
b.	<dogdi>	/dogdi/	→	<dogdi-ge>	dogdi-**gə**	'hear-PERF'
	<bu>	/bu/	→	<bu-ge>	bu-**gə**	'give-PERF'

Nevins interprets [+cg] vs. <-ge> allomorphy as exemplifying "a feature co-occurrence phonotactic (banning [+high] together with [+constricted glottis]) driv[ing] allomorph selection: the ordinary exponence process is overridden by a phonotactic, and another allomorph is chosen instead". Although he does not frame this as POSA *per se*, it meets the definition of it: it is implied that they are suppletive, chosen on the basis of a general phonological constraint.

As with Katu, I dismiss this as a *bona fide* case of POSA by collapsing the allomorphs into a single underlying representation. One additional data point crucial to these efforts involves a small class of roots which end in the consonant /n/, called 'Class II' roots in Nikolaeva & Tolskaya (2011), hereafter (NT). With these roots, the perfect is realized as -kə, whose final vowel harmonizes with non-high vowels (an independent process). The final nasal of the root assimilates to [ŋ].

(18) Udihe perfect form -kə after /n/-final roots

a.	/dian/	diaŋ-**ka**	'say-PERF'	(NT:211)
b.	/ŋələwən/	ŋələwəŋ-**kə**	'frighten-PERF'	(NT:211)
c.	/gun/	guŋ-**kə**	'say-PERF'	(NT:669)

Looking at the three allomorphs now – [+cg], -gə (written <-ge>), and -kə – all three involve (i) the addition of a vocalic node with a mora, and (ii) the addition of some [+back] place feature (whether dorsal or laryngeal). The vowel /ə/ is the minimal vowel in the language as evidenced from epenthesis and vowel harmony patterns and I therefore take it to be the minimal unspecified vowel. Note as well that in intervocalic position /g/ regularly spirantizes to [ɣ] (NT:57).

That these allomorphs are equivalent is seen when some affix intervenes between the root and the perfect suffix, shown in (19) with the plural marker -du in a converb (CONV) structure (b.). These data show that the choice of form is always dictated by the previous segment.

(19) Udihe form of perfect depends on preceding segment (NT:250)

a.	jəx**ə̰ə̰**-si	bu-**gə**-si	diaŋ-**ka**-si
	sing**PERF**-CONV	give-**PERF**-CONV	say-**PERF**-CONV
b.	jəxə-du-**gə**-si	bu-du-**gə**-si	dian-a-du-**gə**-si
	sing-PL-**PERF**-CONV	give-PL-**PERF**-CONV	say-EPEN-PL-**PERF**-CONV

In my counter-analysis, I collapse these forms into a single underlying representation /-kə/, albeit one with a particular property: the segmental root node of /k/ is weak. This weakness can be formalized via Gradient Symbolic Representations (Smolensky & Goldrick 2016), wherein all contrastive segments have a degree of activation between [0] and [1]. Such representations are particularly useful in modeling exceptional behavior not shared with other morphs.[19] In Figure 3, the perfect marker is composed of /-k$_{[0.5]}$ə$_{[1.0]}$/, with a weak /k/ of half strength and a vowel /ə/ with full strength (hereafter just /-k$_{[0.5]}$ə/).

[19] Some recent applications of gradient representations to allomorphy include Revithiadou, Markopoulos, & Spyropoulos (2019), Rosen (2019), Hsu (2019), and Zimmermann (2019, 2020).

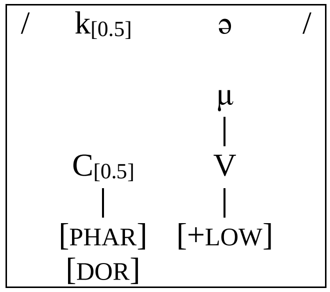


Figure 3: Udihe underlying representation of /-k[0.5]ə/ PERF with gradient structure

In this figure, the vowel is classified as [+LOW] following Ko's (2012: 291) analysis of the Udihe vowel system. Because this is the minimal vowel, it has no other features (cf. /o/ which for Ko additionally has a [LABIAL] feature). All [+LOW] vowels must be identical within a word unless an opaque vowel intervenes, one result being that in "bivocalic clusters only one non-high vowel may be present" (NT:66). I return to this point below.

The consonant's root node is labeled 'C', and only has a strength of [0.5], rendering it susceptible to phonological operations its full counterpart is not. An important part of this representation (independent of its gradience) is that the velar place of articulation is represented with two features: [PHAR] (pharyngeal) which dominates [DOR] (dorsal). This representation with a [PHAR] feature unites all post-palatal places of articulation, and loosely follows Paradis & LaCharité (2001) who use it to explain patterns of loanword adaptation (see also Rose 1996).[20] All members of the velar series /g k x ŋ/ have this configuration in Udihe; no other contrastive post-palatal phonemes exist (at least in this dialect).

With this in mind, let us see how perfect /-k[0.5]ə/ differs from other suffixes that have velar consonants of full strength, such as those in (20). In Table 10, these suffixes are shown in context with the three types of roots, [+LOW], [-LOW], and /n/-final. Note a special kind of affix with a floating [PHAR] feature is also shown (f. below). All examples are from Nikolaeva & Tolskaya, whose page number location is in parentheses. Certain cells of this table are denoted 'n/a' indicating data was not available from the grammar.

[20] Technically, there are two differences that the representation here has compared to that of Paradis & LaCharité (2001:267). First, in Paradis & LaCharité the relevant velars have two sets of place features, one being [ORAL] dominating [DORSAL] (an [ORAL] node it shares with labials and coronals), and the other being [PHARYNGEAL] dominating [DORSAL]. Second, only velar *fricatives* have this representation; velar stops have only the configuration [ORAL]—[DORSAL]. Their precise argumentation is not pertinent to understanding the Udihe patterns, especially given that consonantal contrasts are at the velar place of articulation only.

An alternative compatible with Paradis & LaCharité is a representation /-x[0.5]ə/, rather than /-k[0.5]ə/. Such a representation would actually be closer to the surface realization of intervocalic /g/, which is [ɣ] (as stated above). We could invoke an independently needed constraint *[NASAL][FRICATIVE] to get /…n-xə/ sequences to come out [….ŋke] (such sequences are banned other than in a few loanwords – NT:65). While promising, this alternative is at odds with the known diachrony of consonants in Udihe, to be discussed at the end of this section. Still, it is of interest to note that in Kilen [Glottocode: kile1243], a Tungusic language very closely related to Udihe, perfective aspect is in fact expressed morphologically by suffixes -xə, -xəi, and -xən (Zhang 2013:124).

(20) Udihe suffixes with consonants of full strength

a.	/-kə/	INT	expressive/intensive, describing sudden action	(321-322)
b.	/-kči/	DP	destinative, 'designed for' or 'meant for'	(277)
c.	/-xi/	PROP	proprietive, adjectivizer, 'characteristic of__'	(142-145,192,627-628)
d.	/-gi/	REP	repetitive/regressive, '__ again' or '__ back'	(317-319)
e.	/-ŋie/	IC	imperfective converb, 'when __ was doing'	(237)
f.	/-$^{[PHAR]}$usə/	ADJ	adjectival, negative qualities, deviance from norm	(195)

Affix / Root	/-**k$_{[0.5]}$ə**/ PERF 'perfect'	/-**kə**/ INT 'intensive'	/-**kči**/ DP 'destinative'	/-**xi**/ PROP 'proprietive'	/-**gi**/ REP 'repetitive'	/-**ŋie**/ IC 'imperfective converb'	/-$^{[\text{PHAR}]}$**usə**/ ADJ 'adjectival'
a. [+LOW] …a/ə/o-	zaw**a̰a̰** (< zawa̰-**kə**) grab-PERF (210)	koŋko-**ko**-zoŋo beat-INT-FUT 'will beat' (322)	wakca-**kči** hunt-DP 'meant for hunting' (277)	saŋa-**xi** hole-PROP 'with holes' (192)	zawa-**gi** take-REP 'take back' (318)	wakca-**ŋie**-i hunt-IC-1SG 'when I was hunting' (237)	gænd**a̰a̰**-**usə** be.lazy-ADJ 'lazy, idle' (195)
b. [-LOW] …i/u-	umi-**gə** (< drink-**kə**) drink-PERF (211)	n/a	umi-**kči** drink-DP 'meant for drinking' (235)	kəsi-**xi** luck-PROP 'lucky' (192)	tukti-**gi** climb.up-REP 'climb up again' (317)	bi-**ŋie**-i be-IC-1SG 'when I was (…)' (237)	zomi-**usə** steal-ADJ 'being thief' (195)
c. /n/-final	diaŋ-**ka** (< dian-**kə**) say-PERF (211)	n/a	dian-a-**kči** (< dian-**kči**) say-DP 'meant for saying' (235)	n/a	xekti-**ŋi** (< xektin-**gi**) jump-REP 'jump back' (317)	dia-**ŋie**-ni ~ dian-a-**ŋie**-ni (< dian-**ŋie**-ni) say-IC-3SG 'when he was speaking' (237)	n/a

Table 10: Udihe suffixes of full strength in comparison to weak /-k$_{[0.5]}$ə/ PERF

From this table, the perfect /-k$_{[0.5]}$ə/ differs from the string-identical suffix /-kə/ EXPR which we can interpret as being of full strength, i.e. /-k$_{[1.0]}$ə$_{[1.0]}$/. Data is severely limited of this suffix and in general it has unclear semantics. It is transparently related to the expressive past suffix /-k/ (as in a. below), though full-strength /-kə/ can clearly appear in non-past environments (b.).

(21) Udihe expressive past /-k/ EXPR.PST and intensive /-kə/ INT

a.	agdi	sakinə-:-**k**	tigdə-li-e-**k**	wo:-ini
	thunder	clap-PST-**EXPR.PST**	rain-INC-PST-**EXPR.PST**	do-3SG

'(Suddenly) the thunder broke, and it started raining' (NT:285)

b.	si	ŋənə-**kə**-zəŋə-i	bu-də	xaisi	ŋənə-**kə**-zəŋə-u
	you	go-**INT**-FUT-1SG	we-FOC	also	go-**INT**-FUT-1PL.EX

'You will leave and we will also leave' (NT:322)

Regardless of semantics, both surface as [k] and do not make the preceding vowel creaky, unlike perfect /-k$_{[0.5]}$ə/. The same holds for the destinative particle /-kči/ in Table 10, which is one of many suffixes of the shape /-kCV/.[21]

The next set of suffixes are those which begin with a different velar consonant /x/, /g/, or /ŋ/. One can see that like with the /k/-initial suffixes of full strength, there is no alternation with a creaky vowel depending on the preceding segment. The only change which takes place is the coalescence of /n/ and /g/ to [ŋ] with the suffix /-gi/, and the variation between coalescence and epenthesis with /-ŋie/.

Finally, a particularly illuminating suffix is adjectival /-$^{[PHAR]}$usə/ ADJ. This suffix has a quirk that it makes a preceding [+LOW] vowel creaky, and in this way shares behavior with perfect /-k$_{[0.5]}$ə/. However, if /-$^{[PHAR]}$usə/ follows a [-LOW] vowel, no consonant surfaces between the root and initial vowel of the suffix, nor is there any lengthening. In Table 10, the form is [zomi-usə] rather than ^{x}[zomi-gusə] or ^{x}[zomi-kusə]. We therefore have a three-way suffixal contrast: creaky vowels alternating with nothing (/-$^{[PHAR]}$usə/ ADJ), creaky vowels alternating with a consonant (/-k$_{[0.5]}$ə/ PERF), and a non-alternating consonant (in /-kči/). To capture this contrast, I posit that in this suffix the [PHAR] place feature is floating and not linked to a consonantal root node. I return to this representation shortly.

Having established a range of contrasts in suffixes, let us examine how the gradient representation of the prefect morph (in Figure 3) maps to its various surface forms in the three root contexts. This is shown in the input-output mappings starting with (22) below. The core of the logic here follows from Zimmermann's (2020) discussion of gradience and types of exceptionality, whereby "constraints are violated/satisfied relative to the activity of the relevant elements". For maximum clarity, the phonological structure of the root is in blue, the suffix in red, and any added structure not in the input is gray.

[21] One important observation to note here is that suffixes of the shape /-kV/ are very rare in Udihe (in this dialect at least). The only other case is past tense marking which surfaces as vowel lengthening after [+low] vowels, diphthongization after [-low] vowels, and either [-ə] or [-ki] after /n/-final-roots described as 'free variation' (NT:209-210). I will not deal with the past tense marker in this paper, and remain neutral as to whether this is suppletion or not, and if so whether it is surface-optimizing.

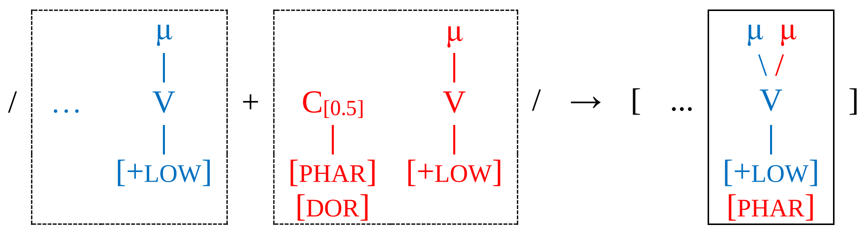
Moreover, there are several clitics of the shape /-kV/, e.g. the indefinite clitic /-kə/ IND, contrastive focus /-kə/ CONT, and constituent disjunction /-kə/ DIS (NT:86-88). Clitics are different from suffixes with respect to stress, but in many other ways pattern like bound suffixes and not independent words (e.g. for vowel harmony) (NT:86ff.). These show no alternation depending on the stem they attach to, as below:

(i)	da:-**ka**	go:-**ko**	bagdi-mi
	short-DIS	long-DIS	live-INF

'They lived for a short time or for a long time' (658)

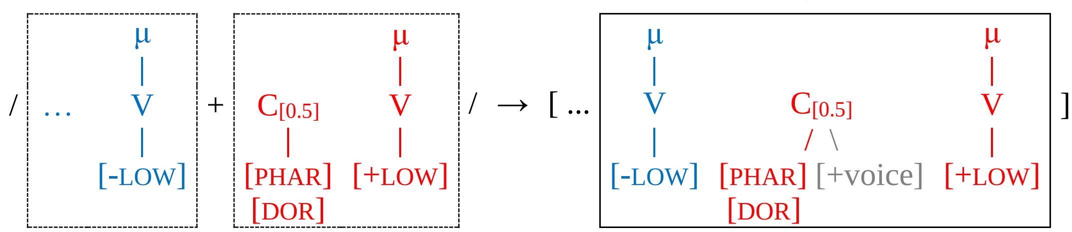
First, (22) shows /-k$_{[0.5]}$ə/ with a [+LOW] vowel. In this case, the [+LOW] feature of the root vowel and the [PHAR] feature of the affix are able to combine. The important assumption here is that creaky vowels are specified as [PHAR] which differentiates them from their non-creaky counterparts. It is by virtue of sharing this [PHAR] feature that velar consonants and creaky vowels may alternate. In the output of (22), the two vocalic nodes coalescence which results in two moras on the remaining vowel node. This is sufficient to license the [PHAR] feature (recall that all creaky vowels are bimoraic). Following Zimmermann's (2020) reasoning, because the root node C$_{[0.5]}$ is weak it more liberally deletes in marked contexts, whereas full segments do not. In our grammar, we posit two constraints ^{x}V$_i$C$_{[PHAR]}$V$_i$ and Max[PHAR].

(22) /… ə k$_{[0.5]}$ ə / → […ə̰ə̰]



In contrast, consider /-k$_{[0.5]}$ə/ with a [-LOW] root vowel in (23). Here, the [PHAR] feature is not able to combine with [-LOW] due to a ban on this feature combination in the phonological grammar (a constraint ^{x}[-LOW][PHAR]). Instead, [PHAR] must be realized as a consonant.[22] Due to its weak strength, it is subject to a constraint on intervocalic voiceless segments, which causes a [+voice] feature to be inserted (a constraint ^{x}VC$_{[-voice]}$V). Strong consonants are not subject to this markedness constraint, and faithfully surface with their input voicing value (e.g. the other affixes in Table 10).

(23) /… i k$_{[0.5]}$ ə / → […igə]

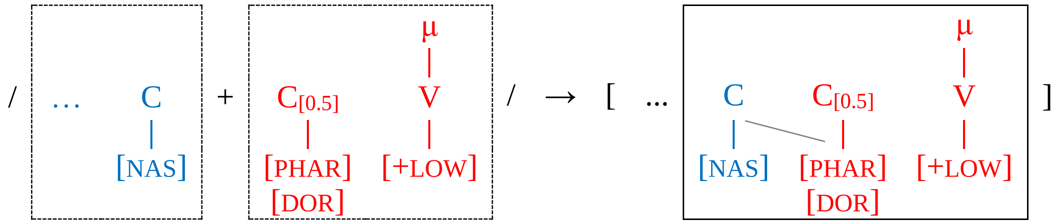


To achieve this output, we add the new constraints ^{x}[-LOW][PHAR] and ^{x}VC$_{[-voice]}$V, plus a constraint Dep[voice], to our grammar.

Next, consider /-k$_{[0.5]}$ə/ with an /n/-final root in (24) which results in a sequence […ŋkə]. Here, the pharyngeal node shares its place feature with the preceding nasal, resulting in assimilation. The consonantal root node is not able to delete here, perhaps bolstered by the presence of the preceding root consonant. The result is an output where the weak /k/ surfaces. It is not between vowels and therefore not subject to ^{x}VC$_{[-voice]}$V.

[22] There is another hypothetical 'repair' for the suffix /-k$_{[0.5]}$ə/ in these contexts: in the output, the feature [PHAR] of the consonant node associates to the vocalic node /ə/. Such an output […iə̰] is not attested. One could eliminate such an output by a version of van Oostendorp's (2007) constraint 'Alternation', situated within some theory of Colored Containment. The central thesis of this theory is that all morphs are endowed with their own morphological 'color' which set them apart from other morphs (i.e. other morphological colors), and that elements of the same morphological color should not be associated in the output if they were not already associated in the input. This would have to be flexible enough to accommodate [PHAR] on the lengthened [+LOW] vowel in (22).

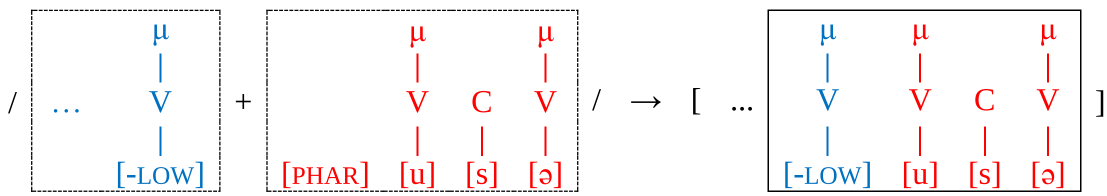
(24) /… n $k_{[0.5]}$ ə / → […ŋkə]



Although there are several technical issues which need to be worked out – e.g. the exact constraint grammar permitting coalescence in (22) but only spreading in (24) – the representations above suffice to show that the surface forms of the Udihe perfect can be captured with a single underlying representation.

Furthermore, compare these structures to the adjectival suffix /-$^{[\text{PHAR}]}$usə/. Here, if the preceding vowel is [+LOW] then the floating [PHAR] feature associates to this vocalic node without complication. However, if the preceding node is [-LOW], it cannot dock due to ^{x}[-LOW][PHAR]. Unlike perfect /-$k_{[0.5]}$ə/ with a weak root node, this adjectival suffix has no root node entirely. Instead of epenthesizing a root node to realize the floating [PHAR] feature, it simply deletes as shown in (25). To capture this we add to our grammar the constraint Dep[C].

(25) /… i [PHAR] u s ə / → […iusə]



Just as we saw for Katu, there are clear historical grounds for a representation /-$k_{[0.5]}$ə/: it reconstructs to an earlier form *-kA (with an unspecified low vowel) (NT:206). Its consonantal origin is still seen in northern dialects of Udihe, where the perfect form is /-ʔə/ with a (consonantal) glottal stop. This represents a key difference between Udihe dialects, as shown in (26). Creaky voice in general descends from intervocalic *-k- in the Udihe of this study (Bikin), which redistributed its laryngeal contrast generally.

(26)	Intervocalic proto-sound	Bikin dialect (this study)		Northern	(NT:8)
a.	*-k-	a̰a̰	('creaky voice')	aʔ	
b.	*-s-, *-x-	aː	(long vowel)	ah	

With the perfect morph, the change from *-k- to creaky voice is incomplete, whose incomplete status can be captured via a gradient representation /-$k_{[0.5]}$ə/. If this representation is accepted, then there is no suppletion here and therefore no support for POSA.

6 Konni

The final POSA case I cross-examine is Konni [kma] (Gur, Niger-Congo: Ghana), as argued by Wolf (2008). All data presented below come from the original source (Cahill 1999), and focus on morphological patterns demonstrating the avoidance of local rhotic flaps (i.e. ^{x}[ɾɾ] and ^{x}[ɾVɾ]). These are categorically banned by the phonological grammar.

The relevant data involve the noun class system of Konni. There are five noun classes in Konni, of which we shall discuss the first four (the fifth is not directly relevant). These classes are distinguished based on the shape of accompanying suffixes on the noun (there is no concord/agreement). While the singular is identical for all four classes (it is /-ŋ́/), the classes differ with respect to the singular definite and the plural (the plural definite is realized via reduplication of the plural). This is shown in (27), where the noun class suffix sets are color-coded. The capital letters indicate vowels underlyingly unspecified for an [ATR] harmony value, and a vowel between dashes is epenthetic.

			SG	SG.DEF	PL
(27)	Konni – noun classes				
a.	Noun class 1		/-ŋ́/	/-ɾÍ/	/-A/
	wíí-	'problem'	wíí-ŋ	wíí-ɾí	wí-à
	bììs-	'breast'	bììs-í-ŋ	bììs-ì-ɾí	bììs-á
b.	Noun class 2		/-ŋ́/	/-kÚ/	/-tÍ/
	dàà-	'wood'	dàá-ŋ	dàà-kʊ́	dàà-tí
	gàɾ-	'clothes'	gàɾ-í-ŋ	gàɾ-ʊ̀-kʊ́	gàt-tí
c.	Noun class 3		/-ŋ́/	/-kÁ/	/-sÍ/
	gbàà-	'dog'	gbàá-ŋ	gbàà-ká	gbàà-sí
	kpáɾ-	'basket'	kpáɾ-í-ŋ	kpáɾ-í-ká	kpáɾ-í-sí
d.	Noun class 4		/-ŋ́/	/-bÚ/	/-tÍ/
	dáá-	'alcohol'	dáá-ŋ	dáá-bʊ́	dáá-tí
	chʊ́áɾ-	'taboo'	chʊ́áɾ-í-ŋ	chʊ́áɾ-í-bʊ́	-

The examples serve to illustrate that noun class membership is not predictable from its phonology.

The relevant morph for our discussion is the class 1 singular definite /-ɾÍ/. Wolf highlights two facts from Cahill. The first is that there are no [ɾ]-final roots in noun class 1, unlike the other three (shown above). This pre-emptively avoids any ˣ[ɾVɾ] violation. Second, there are many roots which show 'mixed class' behavior (~11% of nouns). These select one class affix in the plural, but a different class for the singular definitive. Several of these involve ɾ-final roots and all avoid an ˣ[ɾVɾ] violation as well. An example is /wáɾ-/ 'block', which takes a class 2 singular definite form [wáɾ-í-kʊ́] but a class 1 plural form [wáɾ-à]. There is no case showing the opposite, i.e. a hypothetical ɾ-final root with class 1 singular definitive ˣ/…ɾ-ɾÍ/ but class 2 plural ˣ/…ɾ-tÍ/.

Does this meet the definition of surface-oriented suppletive allomorphy? It certainly supports the pervasiveness of avoiding ˣ[ɾVr] sequences. However, I contend that there is no suppletive allomorphy here because the different affixes belong to distinct morphological classes and therefore are not realizations of the same feature set. In other words, there is never true morphological competition between the set of singular definitive suffixes /-ɾÍ/, /-kÚ/, /-kÁ/, and /-bÚ/, and if there is no competition there can be no phonological grammar acting as judge. It may be plausible that the ˣ[ɾVɾ] constraint played a role diachronically in shaping this system, but it plays no synchronic role in morphological exponence.

The counter-argument to this position would be to identify mixed class ɾ-final roots as actually belonging to class 1, but having the 'wrong form' chosen to avoid ˣ[ɾVɾ] in the synchronic grammar. The problem with this argument is that among the many cases of mixed classes, the vast majority have no relation to the constraint ˣ[ɾVɾ]. Thus, while each of the following mixed classes in (28) (pairs 2/1, 3/1, and 2/3) can be exemplified with a ɾ-final root, this is an incident aspect of the noun class system, rather than a fundamental pattern. Most roots selecting mixed classes do not end in /ɾ/, and in those cases in fact there is no clear role for phonological markedness of any sort. Examples without /ɾ/ are also provided in (28).

(28) Konni mixed noun classes

				SG	SG.DEF	PL
a.	Mixed 2/1	wáɾ-	'block'	wáɾ-í-ŋ	wáɾ-í-kʊ́	wáɾ-à
		nìì-	'rain'	nìí-ŋ	nìì-kʊ́	nì-á
b.	Mixed 3/1	nììɾ-	'shoe'	nììɾ-í-ŋ	nììɾ-ì-ká	nììɾ-á
		yɛ́s-	'potato'	yɛ́ꜜs-í-ŋ	yɛ́ꜜs-í-ká	yɛ́s-à
c.	Mixed 2/3	sàŋkpàɾ-	'navel'	sàŋkpàɾ-í-ŋ	sàŋkpàɾ-ì-kʊ́	sàŋkpàɾ-ì-sí
		kpììl-	'thigh'	kpììl-í-ŋ	kpììl-ì-kʊ́	kpììl-ì-sí

Whatever in the synchronic grammar accounts for the mixed noun classes, the culprit is certainly not phonology.

I highlight two additional problems with Wolf's approach to these Konni facts. First, even if the ^{x}[ɾVɾ]-driven interpretation were accepted for mixed classes, it does not account for the many cases where phonology does *not* override morphology in the noun class system. Cahill identifies several phonological (highly-ranked) constraints in the language, such as ^{x}VVV banning super-long vowels and $C_{iPL}C_{iPL}$ requiring adjacent consonants to have the same place values (pp. 108, 191-193). Unlike ^{x}[ɾVɾ], these constraints do not trigger noun class reorganization, shown in (29).

(29)

	Konni noun classes		SG.DEF	PL	Constraint	Non-existent 'repair'	
a.	Class 1		/-ɾÍ/	/-A/	^{x}VVV		
	dàà-	'day'	dàà-ɾí	dà-ɾ-á	(< dàà-á)	^{x}dàà-tí ~ ^{x}dàà-sí	(CL 2~3 PL)
	wíí-	'problem	wíí-ɾí	wí-à	(< wíí-à)	^{x}wíí-tí ~ ^{x}wíí-sí	(CL 2~3 PL)
b.	Class 1		/-ɾÍ/	/-A/	$C_{iPL}C_{iPL}$		
	sààm-	'porcupine'	sààn-ní	sààm-á	(< sààm-ɾí)	^{x}sààm-bʊ́	(CL 4 SG.DEF)
	tíg-	'house'	tígí-ɾí	tíg-è	(< tíg-ɾí)	^{x}tík-kú ~ ^{x}tík-ké	(CL 2~3 SG.DEF)

In a., a class 1 root with a long vowel still combines with the plural marker /-A/ in violation of ^{x}VVV, instead of combining with a class 2 or 3 equivalent. This is resolved either through /a/-to-[ɾ] rhoticization or root shortening. In b., class 1 roots which end in labials or velars still combine with the coronal-initial singular definite /-ɾÍ/ in violation of $C_{iPL}C_{iPL}$, even though labial and velar initial suffixes of class 2, 3, or 4 are available. Instead, this is resolved through assimilation or epenthesis. Any system where morphology and phonology are fully integrated and conspire to pre-emptively avoid marked structures runs into this problem.

Second, as Wolf actually mentions it is not the case that all potential [ɾɾ]/[ɾVɾ] sequences are pre-emptively *not* created by the morphology. Several ɾ-initial suffixes exist, and to avoid ^{x}[ɾVɾ] violations they show dissimilation to [d] or [t] in the context of a ɾ-final root, dictated by the individual suffix. This is seen in (30).

(30) Konni ɾ-initial suffixes exhibiting dissimilation

a.	/-ɾÚ/ AGENTIVE	/gùù-/	'bury'	[gù-gùù-**ɾú**]	'burier'
		/bɔ̀ɾ-/	'sow'	[bɔ̀-bɔ̀ɾ-ì-**tʊ́**]	'sower'
b.	/-ɾàáŋ/ 'male'	/dù-/	'horse'	[dù-**ɾ**àáŋ]	'stallion'
		/ŋmáɾ-/	'dove'	[ŋmáɾ-í-**d**áꜜáŋ]	'male dove'

Because there are actually phonological means to repair ɾ locality violations, this undermines and underdetermines the role of phonology in preventing their morphological combination in the first place.

7 Discussion

I have presented five case studies of what appear to be phonologically-optimizing suppletive allomorphy (POSA), and for each I have presented a counter-analysis to support an anti-POSA position. I recap the core of my counter-analysis in Table 11.

Language:	Original allomorphs proposed:	Original optimizing constraint(s):	Anti-POSA conclusion:	Anti-POSA counter-analysis:	Anti-POSA support:
§2 Irish	**-axə** vs. **-ənə** [PLURAL]	WSP$_{FT}$ and PRIORITY (don't create non-optimal foot [ˈσ.H])	No optimization	Suppletive morphs sub-categorize for σ-count (or stress position)	*Ad hoc* phonological constraints needed (and evidence that [ax] is not heavy)
§3 Tiene	**-Vk** vs. **-lV-** [STATIVE]	CVC$_2$VC$_3$ template (C2 = [+COR], C3 = [-COR])	No morphemes	Relevant stems are monomorphemic (e.g. ka<**la**>b- divide<STAT> → kalab- 'be.divided')	Paucity of relevant forms (only four **-lV-** stative forms)
§4 Katu	**-an-** vs. **-r-** [NOMINALIZER]	WORD=FT$_{σσ}$ (words are maximally 2σ)	No suppletion	Allomorphs have one UR: (/-**r̩n**-/ → [-**a**-]~[-**r**-]~[-**an**-])	***-rn-** is reconstructed (and exists dialectally)
§5 Udihe	Creaky [**V̰**] vs. **-gə** vs. **-kə** [PERFECT]	ˣ[-LOW][PHAR] (high vowels cannot be creaky)	No suppletion	Allomorphs have one UR: (/-**k[0.5]ə**/ → [**PHAR**] ~[-**gə**]~[-**kə**])	***-kA** is the reconstructed form
§6 Konni	**-rÍ** vs. **-kÚ**/**-kÁ/-bÚ** [NOUN CLASS]	ˣ[ɾVɾ] (ɾ cannot be local to another ɾ)	No suppletion	Relevant morphs are not in morphological competition	Other phonological constraints are inactive (e.g. ˣVVV)

Table 11: Recap of case studies

We can divide the anti-POSA conclusions into three broad types. The first type is exemplified by Irish, and concludes that there is no optimization with the relevant suppletive allomorphs. Here, the POSA interpretation is undermined by the fact that *ad hoc* phonological constraints must be posited to account for the morphological patterns, which are not independently needed by the phonological grammar. Instead, the Irish dialects can be unified by assuming widespread subcategorization frames, which are independently needed and widespread in the Irish plural system.

The second type applies to Katu, Udihe, and Konni, where the conclusion is that there is no suppletion. For the first two, I have posited that there is actually only one UR from which all surface forms can be derived. In both cases, the UR is supported by diachrony and the derivations involve straightforward and typologically well-grounded phonological alternations. For the Konni case, the relevant morphs do not collapse to a single UR. Rather, they are not actually in morphological competition vying to realize the same morphosyntactic feature bundle. If one were to assume that they were in competition (required for a POSA interpretation), then this does not explain why only one phonological constraint plays a morphological role instead of *all* phonological constraints.

The third and final type is in Tiene, where I presented a reanalysis where the relevant stems are not actually multi-morphemic, i.e. they do not contain any synchronically separable stative affix. If there are no distinct morphemes here, then POSA by its very definition is not a possible interpretation of the data.

These three 'strategies' for cross-examining cases of POSA have been applied or can apply across the literature. Many of the examples brought up in Mascaró (2007) can be reinterpreted as a single underlying representation. For example, Basque [eus] morphemes which undergo idiosyncratic voicing such as verbal participle {-tu, -du} (plausibly reanalyzed as a form /-Tu/ underspecified for voicing), or morphemes which show exceptional overassimilation in Baix Empordà Catalan [cat], such as the infinitive marker {ɾ > (n, l, t, s)} (plausibly reanalyzed as an underspecified coronal consonant). In general, enriching and impoverishing phonological representations is one prominent way to capture exceptional effects of morphs.[23]

Further, the pro-POSA camp makes a faulty prediction by integrating phonological constraints with morphological exponence: we expect there to be alternations when one corner of an otherwise optimizing pattern turns out to actually be non-optimizing. Consider a representative example from Latin [lat]). Mester (1994) claims that in conjugation class II verbs, the perfect has two suppletive allomorphs: /-u/ occurs with metrically light stems while /-s/ occurs with heavy stems. Mester attributes this distribution to the avoidance of 'medial trapping', i.e. the avoidance of structures …[σ̄]σ̆<σ̄>, where an unparsed light syllable appears between a footed syllable and the final extrametrical syllable. This is shown in (31), with 1SG forms.

(31) Latin conjugation class II perfect suppletion – /-u/ with light stems, /-s/ with heavy stems

a.	Light stem	mon-ē-re 'warn'	1SG	mon-**u**-ī	[mon**u**]<ī>	[σ̆σ̆]<σ̄>
b.	Heavy stem	aug-ē-re 'increase'	1SG	aug-**s**-ī	[aug]<**s**ī>	[σ̄]<σ̄>
				ˣaug-**u**-ī	ˣ[au]g**u**<ī>	ˣ[σ̄]σ̆<σ̄>

Contra Mester, Embick (2010:172ff.) presents several places where an analysis as optimization predicts the wrong forms. One are 1PL forms, repeated below:

[23] Recent works include Scheer's (2016) 'rescue segments' and various abstractions in Zimmermann (2016, 2017, 2019), such as the use of 'ghost segments'. For historical context of this approach and much additional literature, see Newell & Ulfsbjorninn (2018)'s opening remarks for the MfM 2018 Fringe session.

(32) Latin perfect suppletion – Wrong forms predicted under optimization (Embick 2010:173)

a.	Light stem	1PL	mon-**u**-imus	mo[n**u**i]<mus>	σ̆[σ̆σ̆]<σ̄>
b.	Heavy stem	1PL	aug-**s**-imus	[aug]**si**<mus>	[σ̄]σ̆<σ̄>
			^{x}aug-**u**-imus	^{x}[au][g**u**i]<mus>	^{x}[σ̄][σ̆σ̆]<σ̄>

Here, as in (31), the /-u/ allomorph appears with the light stem /mon-/ (a short vowel) while /-s/ appears with the heavy stem /aug-/ (a diphthong). However, the result is that the /-s/ allomorph (b.) is in a 'trapped' position which is less optimal. The more optimal would be with /-u/ but this is ungrammatical. Embick concludes that proposals like Mester's generally "apply only to a carefully selected set of forms and make incorrect predictions when extended beyond these" (p. 172).[24]

Cases like Latin (and the range of data in the case studies above) can straightforwardly be captured via subcategorization frames which are idiosyncratically linked to the suppletive allomorphs (shown in Figure 4, modeled after Figure 1). This correctly predicts that subcategorized phonological material is the only phonological material which the morph is sensitive to.

[[σ̆]	$\boxed{\text{u}}$	...]VERB	vs.	[[σ̄]	$\boxed{\text{s}}$	...]VERB
STEM	PERF			STEM	PERF	

Figure 4: Latin subcategorization frames for class II perfect allomorphs

8 Summary

This paper has argued against phonologically-optimizing suppletive allomorphy (POSA), whereby the phonological grammar chooses the suppletive allomorph whose output is least phonologically marked. For Irish I argued that a POSA interpretation is undermined by the fact that *ad hoc* phonological constraints must be posited to actually result in optimization, constraints which are not independently needed by the phonological grammar. For Tiene, I argued that the relevant stems are essentially limited to six forms and are not actually multi-morphemic (i.e. there is no synchronically separable affix). For Katu and Udihe, I posited that there is only one underlying representation from which all the surface forms can be derived, whose abstract forms actually match proto-forms. Udihe specifically involved Gradient Symbolic Representation (Smolensky & Goldrick 2016), where I posited that the underlying consonant is weak (i.e. has a value of [0.5]). Finally, for Konni I argued that the suppletive morphs in question are not actually in competition, and if they were it predicts many more instances of POSA than are found. In total, this paper asserts that the most straightforward analysis of these data is simply to formalize the conditioning phonological environment via subcategorization frames. This correctly predicts that subcategorized phonological material is the only phonological material which suppletion is

[24] A parallel case is recently discussed in Stanton (2020) for Yindjibarndi [yij] (Pama-Nyungan: Australia, citing Wordick 1982). The relevant suppletive allomorphs are locative /-ŋka/ vs. /-la/ and instrumental /-ŋku/ vs. /-lu/, which are distributed according to mora count. Briefly, the ŋk-form appears when the root is bimoraic and vowel-final, while the l-form is elsewhere. Although the patterns may in principle be captured via a POSA analysis (with PRIORITY and ^{x}CCC constraints), it fails to account for an important subset of patterns where the *more* marked allomorph is chosen. This involves sequences of pre-nasalized consonants, which are categorically banned (^{xN}CV^{N}C) and generally resolved via dissimilation, e.g. /mu**nt**i+**mp**a/ → [mu**nt**i-**p**a] 'really-TOP'. In the suppletive cases, however, Stanton shows that instead of simply avoiding this marked pattern by choosing the l-form, the ŋk-form is still chosen if its conditioning phonological context is met. It then undergoes general dissimilation, e.g. /wu**nt**u-**ŋk**a/ → [wu**nt**u-**w**a] 'rive-LOC' (not ^{x}[wuntu-la]). Stanton concludes that "if we allow the grammar to treat suppletion as a potential repair to a phonotactic problem that can be prioritized over other repairs, like deletion, then we expect the hierarchy among these possible repairs to hold in all cases where both repairs are in principle available". Yindjibarndi does not meet these expectations.

sensitive to. The ultimate conclusion is that suppletion is not sensitive to the outputs of the phonological grammar. Phonological optimization may alter the surface form of morphs, but it does choose among suppletive allomorphs in the first place.

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